

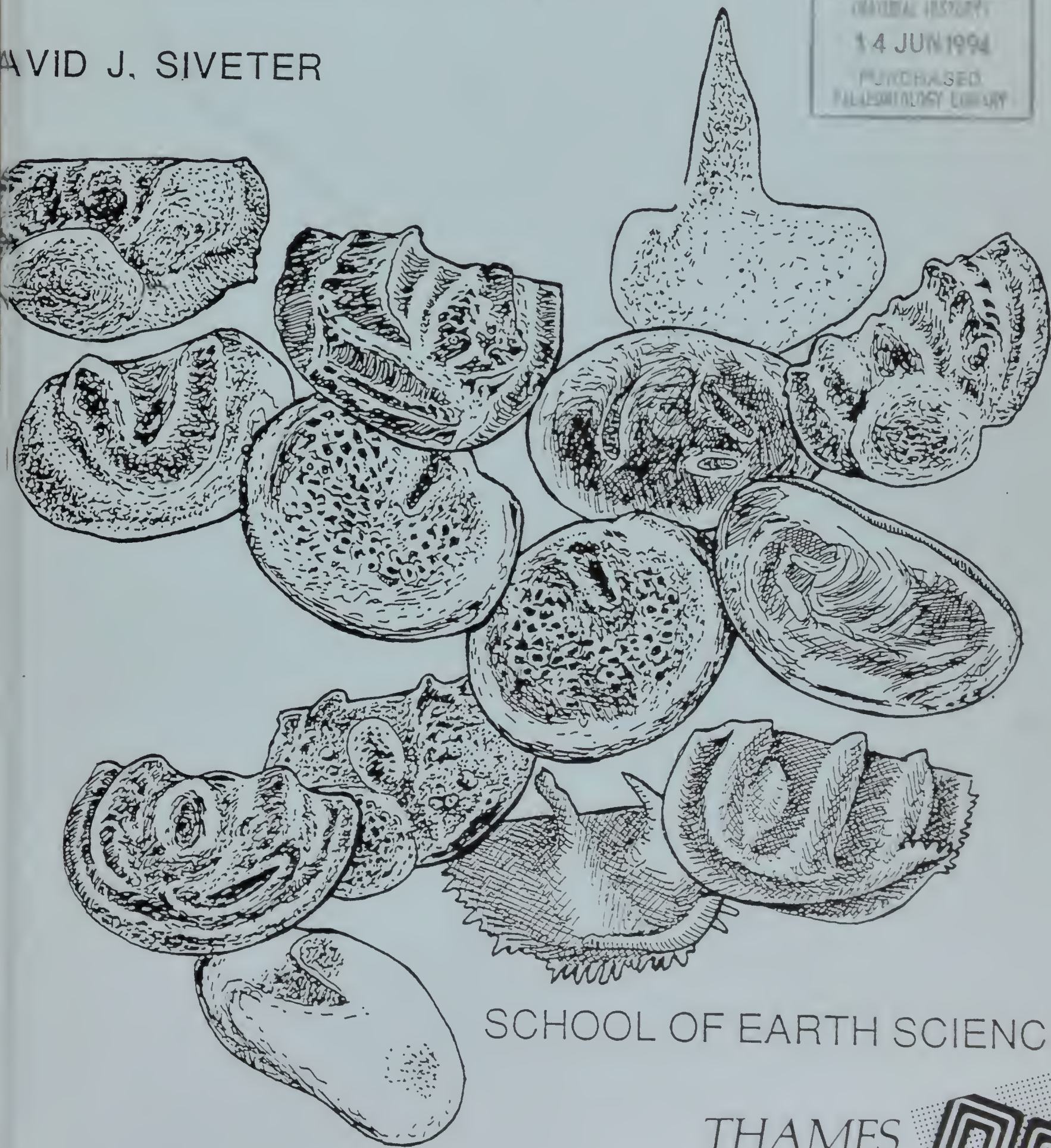
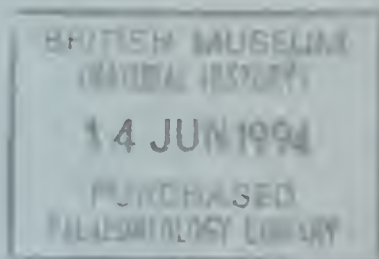
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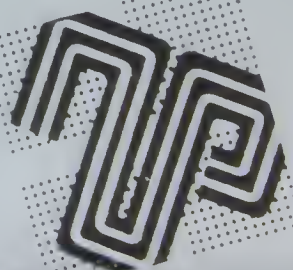
THE LOWER PALAEOZOIC OF THE NORTHERN WELSH
BORDERLAND AND SOUTH WALES

DAVID J. SIVETER



SCHOOL OF EARTH SCIENCES

THAMES
Polytechnic
LONDON





THE LOWER PALAEOZOIC OF THE NORTHERN WELSH BORDERLAND AND SOUTH WALES

Field Guide for the Tenth International Symposium on Ostracoda
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DAVID J. SIVETER K

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INTRODUCTION

This field guide was written for the occasion of the three-day pre-Symposium field excursion to the Lower Palaeozoic of Wales and the Welsh Borderland of England. Within the time schedule available, the excursion is designed to illustrate and collect ostracods representing a variety of modes of preservation and possible lifestyles from a range of palaeoenvironments in the Ordovician and Silurian of the Welsh Basin. The areas and localities selected for this field guide also acknowledge recent research undertaken on the ostracod faunas of the area and the abundance of occurrence of those ostracods.

The Welsh Basin is a classical area for geological and ostracod studies. Based on their researches in the area Adam Sedgwick and Roderick Murchison published the terms Silurian and Cambrian in 1835, and the first ostracods to be figured from the area appeared in Murchison's keystone volume on "The Silurian System" (1839). In spite of this long history of study modern researches, especially reappraisals of stratigraphy, palaeontology, sedimentology and volcanicity, are constantly shedding new light and interpretations particularly on the palaeoenvironments and the plate tectonic setting of Welsh Basin geology. Certainly it is only in the last 20 years that micropalaeontological studies in general and ostracod studies in particular have begun to demonstrate their true biostratigraphical, palaeoecological and palaeogeographical potential in the area.

The first day of the excursion examines essentially shelf sediments of Ordovician and Silurian age in Shropshire in the northern Welsh Borderland (Stops 1-9), including deposits in the type areas for the Caradoc Series and the Wenlock Series. This theme is taken up again in Shropshire on the second day with stops in the Ordovician Caradoc Series of the Shelve inlier (Stop 11) and in the type Ludlow Series and the Pridoli Series in the region of the Ludlow anticline (Stops 10, 12). In traversing across the Welsh Basin examination of deeper water Silurian shales allows collection of morphologically distinctive offshore ostracods (Stop 13). The third day of the excursion concentrates on collecting from around the type area of the Llandeilo Series and in the nearby Narberth district in South Wales (Stops 14-16).

Access to a number of the localities described in this guide is possible only by prior arrangement with the relevant land owners, from whom permission for visits should be sought.

It should also be noted that many of the localities featured in this guide are relatively small and in some cases are protected geological sites. Visitors should ensure that localities are not abused and should not undertake 'casual' collecting or over-collecting of samples.

Acknowledgements:

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I am grateful to Mark Williams (University of Leicester) for providing field assistance and to Robert Lundin, Jean Vannier, Christine Mawby, Adelaide Holmes, Rod Branson and Pauline Siveter for their help in preparing this guide.

I thank the following for allowing reproduction of Text-figures: Dr. M.G. Bassett, Dr. C.R. Jones, Dr. P. Toghill.

Maps:

Geological Survey (GS) and Ordnance Survey (OS) maps pertinent to the general areas covered in this field guide are:

Northern Welsh Borderland (Shropshire):

GS sheets (1:25,000 or 1:50,000) for Leintwardine-Ludlow (Special sheet: parts of SO 47, 57), Church Stretton (SO 49), Craven Arms (SO 48), Telford (SJ 60 and parts of SJ 61, 70 and 71) and Shrewsbury (152).

OS 1:50,000 sheets for Ludlow & Wenlock Edge (137), Shrewsbury (126) and Stafford (127).

Mid-Wales:

OS 1:50,000 sheet for Prestigne and Hay-on-Wye (148).

South Wales:

GS 1:50,000 sheet for Carmarthen (229).

OS 1:50,000 sheets for Tenby (158) and Swansea (157).

Repositories:

The specimens figured in plates 1 and 2 are in the following institutes:

BM: British Museum (Natural History), London.

GSM: British Geological Survey, Keyworth, Nottingham

GEOLOGY OF THE WELSH BASIN

The area of Wales and its contiguous margins across the Welsh Borderland and English Midlands to the east and southeast (see Text-figs. 1, 2) is generally acknowledged to have been the site of an ensialic marginal or back-arc basin on the southern margin of the Iapetus Ocean during late Pre-Cambrian through to Silurian times. Throughout the Lower Palaeozoic, southern Britain (south of the Southern Uplands of Scotland), including the Welsh Basin, is believed to have been part of a microcontinent (Avalonia) which drifted slowly northwards from initially high, to near equatorial latitudes by the Silurian (e.g. see Pickering et al. 1988). The later stages of this northerly drift, during the late Ordovician through Silurian times, coincided with the gradual demise of the Iapetus Ocean in the area and the formation of many of the Caledonian structural features with their characteristic NE-SW trend. The Welsh Basin was, however, tectonically active throughout its early Palaeozoic history (Woodcock 1984).

Regional structural features in the Welsh Basin are dominated by large, relatively open folds and generally high angle fault systems. Many major faults clearly influenced patterns of sedimentation, in some cases throughout the Lower Palaeozoic, and many of the faults demonstrate basement control related to the largely subsurface late Pre-Cambrian continental crust. Deformation of the Caledonian rocks of the Welsh Basin, which continued at least until early/mid Devonian times, shows both strike-slip and dip-slip components and was accompanied by low grade regional metamorphism throughout the area. The collision between North American and 'European' plates resulted in the formation of the Old Red Sandstone continent.

The axis of the Lower Palaeozoic Welsh Basin trends approximately NE-SW along strike through central Wales. The south/southeastern/eastern margin of the basin is more easily defined than the northern margin. Numerous transgressive and regressive sea level pulses combined with local tectonic and (particularly throughout the Ordovician) volcanic events to produce an often complex, lateral and vertical interdigitating facies mosaic throughout the period. Even coeval successions in quite close geographical proximity can illustrate very different facies signatures. In general the more offshore, deeper water deposits, such as graptolitic shales, turbidites and fan deposits occur in central Wales, and the more shelly-rich shallow marine sediments occur in South Wales (typically south of the Towy Anticline), the Welsh Borderland and across to the English Midlands, thus reflecting the position of the marginal platform regions. The western/northern margin of the basin is represented by Lower Palaeozoic successions on Anglesey, an area which is generally considered to have been a topographic high and to have been the source for much of the sedimentary material now found in North Wales.

In the Welsh basin the base of the Cambrian is not commonly exposed; also, the upper part of the Cambrian has traditionally been taken to include the Tremadoc Series. The historical type area for the Cambrian is North Wales, where comparatively deep water sediments - turbidites, greywackes, shales and some conglomerates - dominate a 3000m sequence. Cambrian sediments also form the Caernarvonshire slate belt, between Snowdonia and Anglesey in North Wales. Elsewhere, Cambrian outcrops are mainly scattered around the margins of the Welsh Basin, in SW Wales and in the Malverns and Shropshire areas (The Wrekin and Caer Caradoc districts) of the Welsh Borderland.

Text-fig. 1. Summary of chronostratigraphical classification of Lower Palaeozoic rocks in Wales and the Welsh Borderland, with data for geochronological calibration and the biostratigraphical bases for correlation (from Bassett 1984). Chronometric ages for the base of each System and Series are interpolations using data from many sources worldwide; ages in the centre of this column are restricted to samples from Wales and England whose stratigraphical positions are known within close limits; bracketed ages to the right also refer to stratigraphically well localised samples from Wales and England but whose analytical errors are considered to be outside an acceptable range. Graptolite and conodont biozones are those proved to be present in Wales and England; most are recognised internationally apart from a few of the Silurian conodont 'zones' that are diagnostic local ranges. The shelly faunas listed (trilobites, brachiopods, ostracodes) are also all taxa that occur in the region; apart from some of the Cambrian trilobites, their distributions are not considered to be of biozonal status but they are used here as examples of the reasonably diagnostic correlative value of such faunas within varying limits of accuracy.

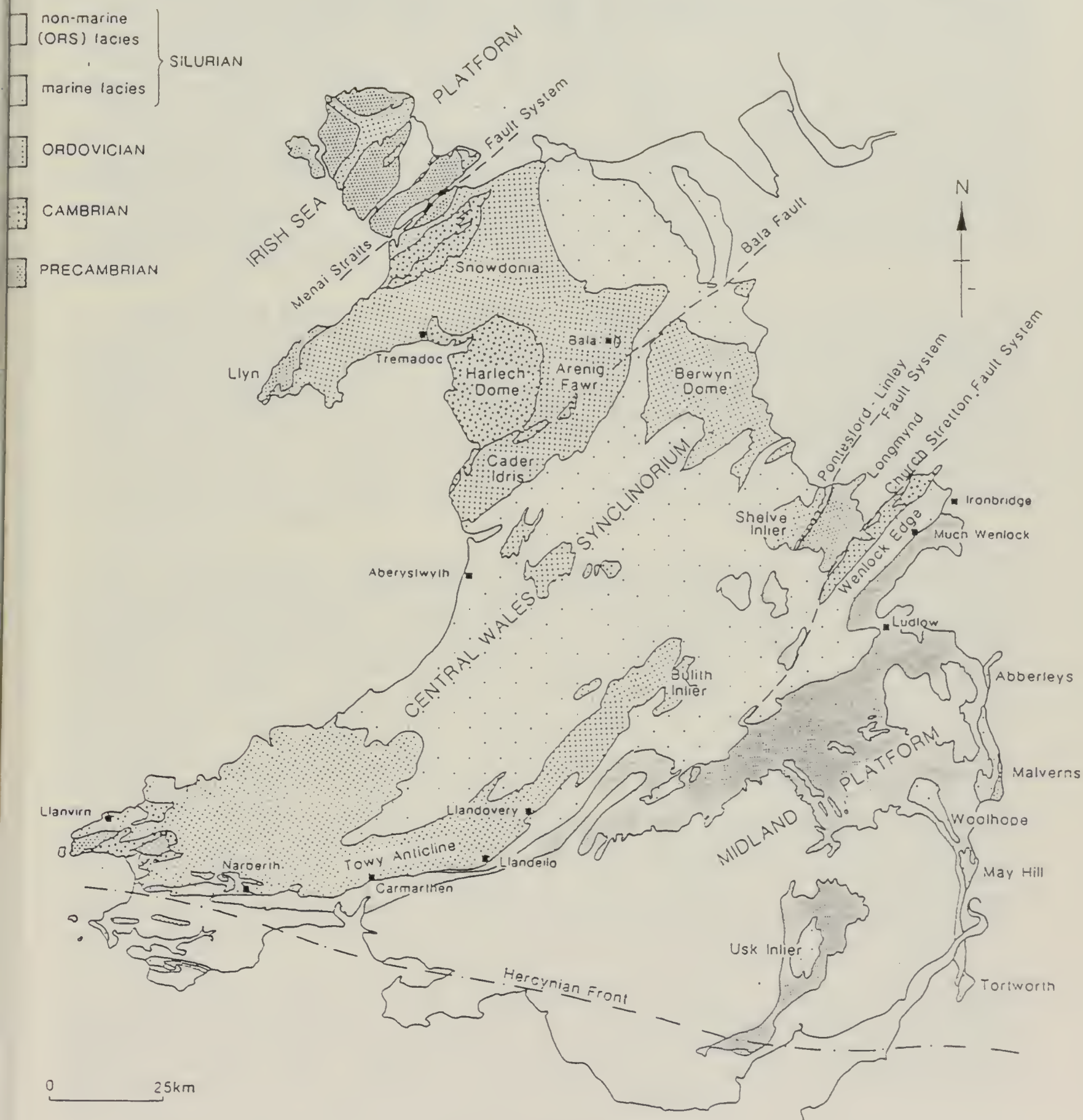
In South Wales the Cambrian is best developed around the St. David's region, where some 16000m of sandstones, shales and muds were deposited in generally relatively shallower water environments. In Shropshire, as in South Wales, the Cambrian sequence (700m) records an overall gradual transgression. Glauconitic and phosphatic limestones and sandstones appear above basal Cambrian quartzites in Shropshire, in a succession also characteristic of coeval outcrops in the English Midlands such as the Nuneaton district. These shallower water sequences record the early Cambrian radiation of Metazoan invertebrate life, including the occurrence of diverse trace fossil assemblages and elements of the Tommotian fauna.

Following a late Tremadoc regression, there was a transgression during the Arenig in the Welsh Basin. Subsidence continued over much of the basin throughout the Ordovician and was combined with many major episodes of igneous activity at several centres in South Wales, the Welsh Borderland and North Wales. In addition to the igneous suites, three broad facies belts can be recognised for the Ordovician of the Welsh Basin (Bassett 1980), though turbidite deposition is conspicuously absent by comparison with the Cambrian. Facies variation is often extremely complex. Mainly shallow water, shelly facies (limestones, sandstones) covered the eastern Welsh Borderland (e.g. Caradoc district; Stop 1); graptolitic shales were deposited in the axial part of the basin (central Wales); in between was an area characterised by mixed shelly and graptolitic facies which now outcrop across North Wales north of the Bala fault and swing south through the western Welsh Borderland (e.g. Shelve district; Stop 11) and South Wales (e.g. Llandeilo - Narberth area; Stops 14-16) to the Pembrokeshire coast. The Ordovician successions in the Shelve inlier and Caradoc districts contrast perfectly the faunal and facies changes between more basinal and more platform environments respectively (see under Stops 1 and 11).

The early Silurian, Llandovery - early Ludlow eastwards transgression resulted in the submergence of much of the eastern Welsh Borderland and English Midlands platform (Stops 3-9). Minor regressive events are coincidental with the deposition of limestone in parts of the Welsh Borderland during the basal (Woolhope Limestone) and late (Much Wenlock Limestone Formation) Wenlock. This is the first occasion during the Lower Palaeozoic that substantial and reef-rich carbonate deposition (Stops 3, 5, 7) had occurred in the platform areas contiguous with the Welsh basin.

During the later part of Ludlow times a regressive pulse began which culminated in the occurrence of reduced marine ('Old Red Sandstone' e.g. Stop 10) conditions during the Pridoli and eventually non-marine, fluvial conditions during the latest Silurian-Devonian (Dittonian). The onset of 'Old Red Sandstone' conditions was not contemporaneous throughout the basin; for example, in Pembrokeshire (SW Wales) red bed conditions may have occurred as early as the late Wenlock. Local tectonic events may have influenced patterns of sedimentation. The Old Red Sandstone sediments of the Welsh basin are palaeontologically significant in containing important faunas of early fish and floras of early vascular land plants.

The deeper parts of the Welsh Basin during the Silurian covered much of what is now North and Central Wales. Here, through much of the early Silurian, turbidite deposition was again an important element, as was the accumulation of off-shore graptolitic muds (Stop 13). Again by contrast to the Ordovician of the area, igneous activity was uncommon during the Silurian, and was apparently confined to areas adjacent to the southern margins of the basin (e.g. Pembrokeshire).



Text-fig. 2. Distribution of Pre-Cambrian and Lower Palaeozoic rocks of Wales and the Welsh Borderland (redrawn with modifications from Bassett 1984, Bassett *et al.* 1986). Some structural elements and palaeogeographical features are also shown.

Other pertinent details of the regional geology of the areas to be visited are given under the relevant section on localities. Detailed correlation of the Cambrian, Ordovician and Silurian rocks of the British Isles are given in the Special Reports of the Geological Society of London (Cowie et al. 1972, Williams et al. 1972, Cocks et al. 1971).

HISTORY OF OSTRACOD STUDIES

Siveter has detailed the history of studies on British Ordovician (1978a) and Silurian (1978b) ostracods, with its concentration on faunas from the Welsh Basin. The first ostracod to be figured from the Lower Palaeozoic of the British Isles was the single crustacean which the 19th century natural historian James de C. Sowerby figured in a section on fossil shells in Murchison's classic "Silurian System" (1839). The specimen in question, now recognised as a kloedeniine beyrichiacean valve came from the Pridoli Series at Downton in the Ludlow area. Others to contribute to the initial documentation of British Lower Palaeozoic ostracods included James Salter (e.g. 1848), palaeontologist at the Geological Survey and Frederick McCoy (e.g. 1846) sometime Professor of Geology at Queen's University in Ireland.

During the middle to later part of the last century relevant ostracod studies were almost solely due to T.R. Jones and his associates and fellow collectors from many parts of Britain (Siveter 1978a, b). Together with sometime co-authors such as H.B. Holl, and armed with material sent for study by worthy amateurs such as (for Welsh Borderland specimens) George Vine, John Smith and George Maw, Jones chronicled such finds in a formidable list of papers for almost fifty years and established most of the British Lower Palaeozoic ostracod taxa bequeathed to the post-1950 generation of researchers.

In the context of this field guide it is particularly worth noting that Smith (of Kilwinning, Scotland) was particularly mindful of the importance of documenting his exact localities in the 'English Silurians' of the West Midlands, Shropshire, the Malverns, Ledbury and the Woolhope district, from which he obtained samples for ostracods (1881, 1892). It was from Maw's Silurian 'Wenlock Shale' washings that Vine picked the ostracod faunas later offered to Jones & Holl (1886a, 1886b; see also Jones 1887a, 1887b) for study. The recording of localities and horizons of this material represents the first real use of ostracods as biostratigraphical tools in the British Lower Palaeozoic (see Vine 1882, 1887, 1888). George Maw, collector geologist, botanist (monographer of the genus Crocus and field companion of Sir Joseph Hooker) and Victorian industrialist (his factory at Jackfield, Ironbridge, Shropshire, led the world in tile manufacture), lived at Benthall Hall on Benthall Edge between Much Wenlock and Ironbridge. He also supplied much of the Silurian material for Davidson's monumental work on British brachiopods (e.g. see Davidson & Maw 1881).

The period 1900-1960 saw very few publications on Lower Palaeozoic ostracods from Britain. Exceptions include Harper's papers on some Llandovery and Caradoc species from the Welsh Borderland (1940, 1947) and Straw's (1929, 1933) comments on Ludlow-Downton series ostracods in the Welsh Basin and in subsurface rocks to the southeast.

In part stimulated by research elsewhere, such as Scandinavia and the East Baltic, there has been a post-1960 revival in the study and potential geological use of British Lower Palaeozoic ostracods. Complete documentation of such studies can be found by consulting Siveter (1978a) and Jones (1986, 1987) for Ordovician ostracods and Siveter (1978b, 1980, 1984, 1988) and Siveter et al. (1987) for Silurian ostracods.

Martinsson's work in the Baltic necessarily involved occasional forays in Britain (e.g. 1963, 1965). Shaw (1969, 1971) described ostracods from the 'Downtonian' of the Welsh Borderland and the upper Silurian of northern England. Siveter published taxonomic-biostratigraphical reviews of all

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British Ordovician and Silurian ostracods (1978a, 1978b). Peterson and Lundin (1974, 1987) and Lundin & Peterson (1975) have revised some Welsh Borderland non-palaeocene Silurian taxa and Siveter's (1980) British Silurian beyrichiacean material consists largely of Welsh Basin material. Jones (1986, 1987) described the Ordovician ostracods of the Welsh Basin as a part of his monograph on Llandeilo and Caradoc beyrichiocopes from England and Wales. Both the ecology and the biostratigraphy and correlative potential of British Silurian ostracods have also recently been treated (Siveter 1984, 1988), including description of probable pelagic forms (e.g. Siveter *et al.* 1987). Welsh Basin ostracods are also now being used as aids in tectonic and palaeogeographic studies (Schallreuter & Siveter 1985; Vannier, Siveter & Schallreuter 1989).

PRESERVATION OF OSTRACODS AND SAMPLING TECHNIQUES

There is a range of types of preservation of the Lower Palaeozoic ostracods of the Welsh Basin. Some occur as calcareous shells, some as decalcified 'mould' faunas and some as silicified material. Each type of material is associated with particular sediments and requires individual field sampling and laboratory processing techniques, details of which are described in Siveter (1980, 1982a) and Jones (1986).

Calcareous valves are recoverable as isolated shells from marls, shales, clays and weathered limestones using washing and sieving techniques. For sample disaggregation this involves using simply hot water or, in the case of the more calcareous mudrock, hydrogen peroxide. Many Silurian (e.g. Llandovery and Wenlock) deposits in the Welsh Basin lend themselves to such processing techniques for the recovery of ostracods (e.g. Stops 3-9) but the Ordovician sediments apparently do not (Siveter 1978b, Jones 1986).

Internal and external ostracod moulds are quite common at certain horizons in Ordovician (e.g. Caradoc Series) and Silurian (e.g. Ludlow and Pridoli Series) siltstones and sandstones of the Welsh Basin (e.g. Stops 1, 10-13). In the field, ostracod moulds may be thickly strewn upon bedding surfaces, particularly in the Ordovician in areas such as the Shelve or Caradoc districts. Casting techniques, using silicone rubber, enable recovery of the external morphology of ostracod valves (see Siveter, 1982a), including full replication of fine details of ornament.

Some calcareous valves may be obtained from limestone by bulk sampling methods and simple mechanical preparation of the valves on the parent slab using fine needles and a 'Vibro-tool'. This technique is particularly useful for those limestones, of all ages, which do not lend themselves to 'debris' sampling.

Much of the known ostracod material from the Ordovician of the Welsh Basin is silicified, virtually all of which comes from the Llandeilo (-Caradoc?) of South Wales (e.g. Stops 14-16). Specimen recovery employs bulk sampling of limestone slabs and acid treatment to release the silicified valves and carapaces from the carbonate matrix. Ideal lithologies are unweathered biomicrites and biosparites. In the middle Ordovician limestones of South Wales, the occurrence of trinulciid trilobites and associated brachiopods have proved, in the field, good markers to ostracod rich horizons (Jones 1986). This technique has not been known to yield ostracods from any Silurian carbonate of the Welsh Basin.

OSTRACOD BIOSTRATIGRAPHY

Cambrian:

Cambrian localities are not included in this field guide. British Cambrian ostracods currently have little biostratigraphical value. Ostracods have been reported from the Cambrian (including Tremadoc) of Wales and the Welsh Borderland though they are very rare and are mostly unrevised. Jones described three taxa (1856, 1881a, 1881b), Leperditia solvensis, Leperditia hicksii and Beyrichia hollii, from the middle Cambrian of Pembrokeshire (=Dyfed), South Wales and Primitia has been recorded from "the Olenus-shales" of the Wrekin district, Shropshire (Jones & Holl 1869). Later, Groom (1901) established the genus Polyphma on Cambrian material from the Malverns.

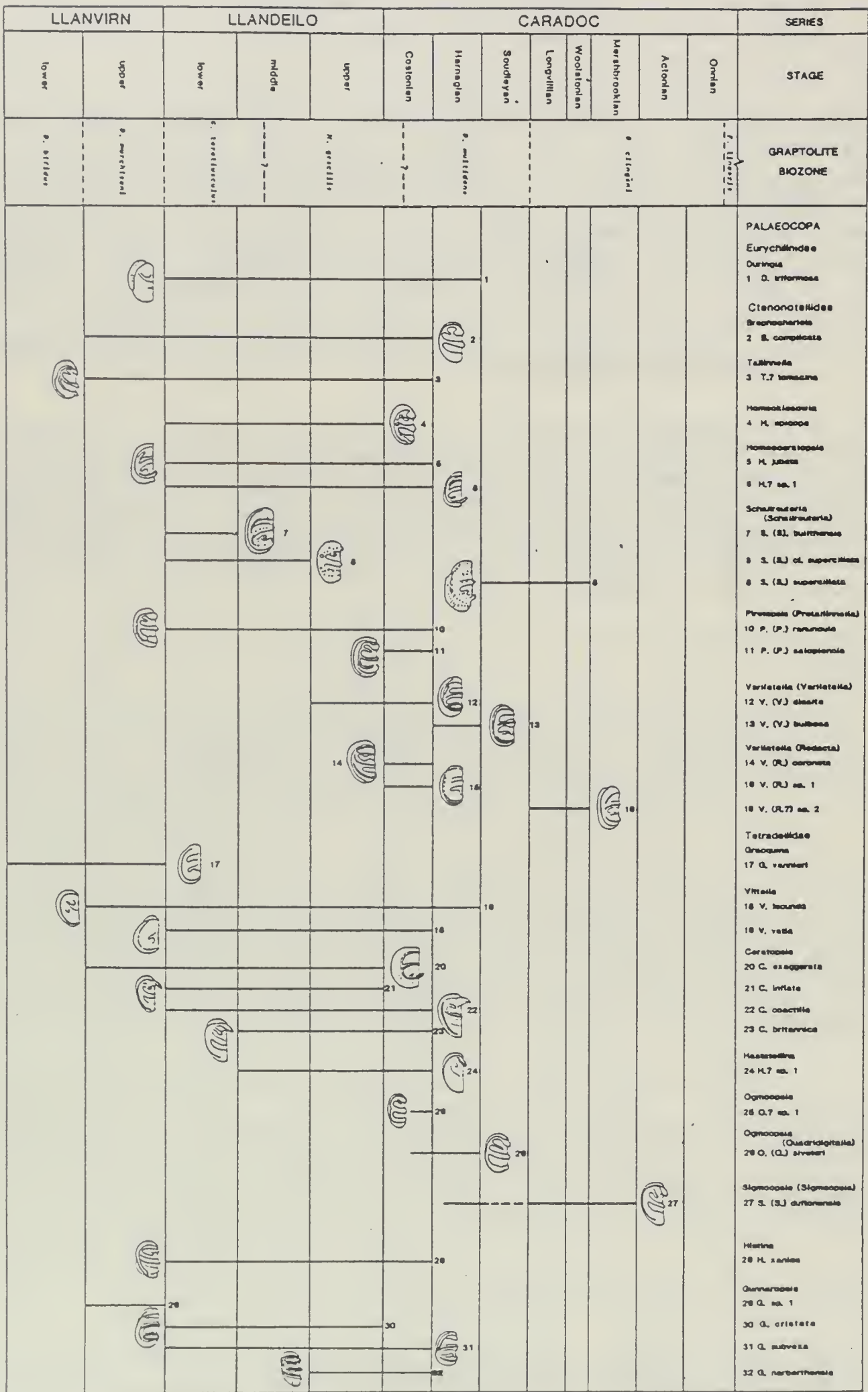
Some of the supposed ostracods in the British Cambrian (-Tremadoc) may turn out to be spurious, but some are undoubtedly records of 'Bradoriida'. For example, the fauna of the Lower Cambrian Caerfai Bay Shales of SW Dyfed, Wales, includes the inarticulate brachiopod Lingulella and the bradoriid Indiana ? (Rushton 1974). Cambrian bradoriid ostracods have been described from elsewhere in Britain from localities in east central England (e.g. Rushton 1978).

Ordovician:

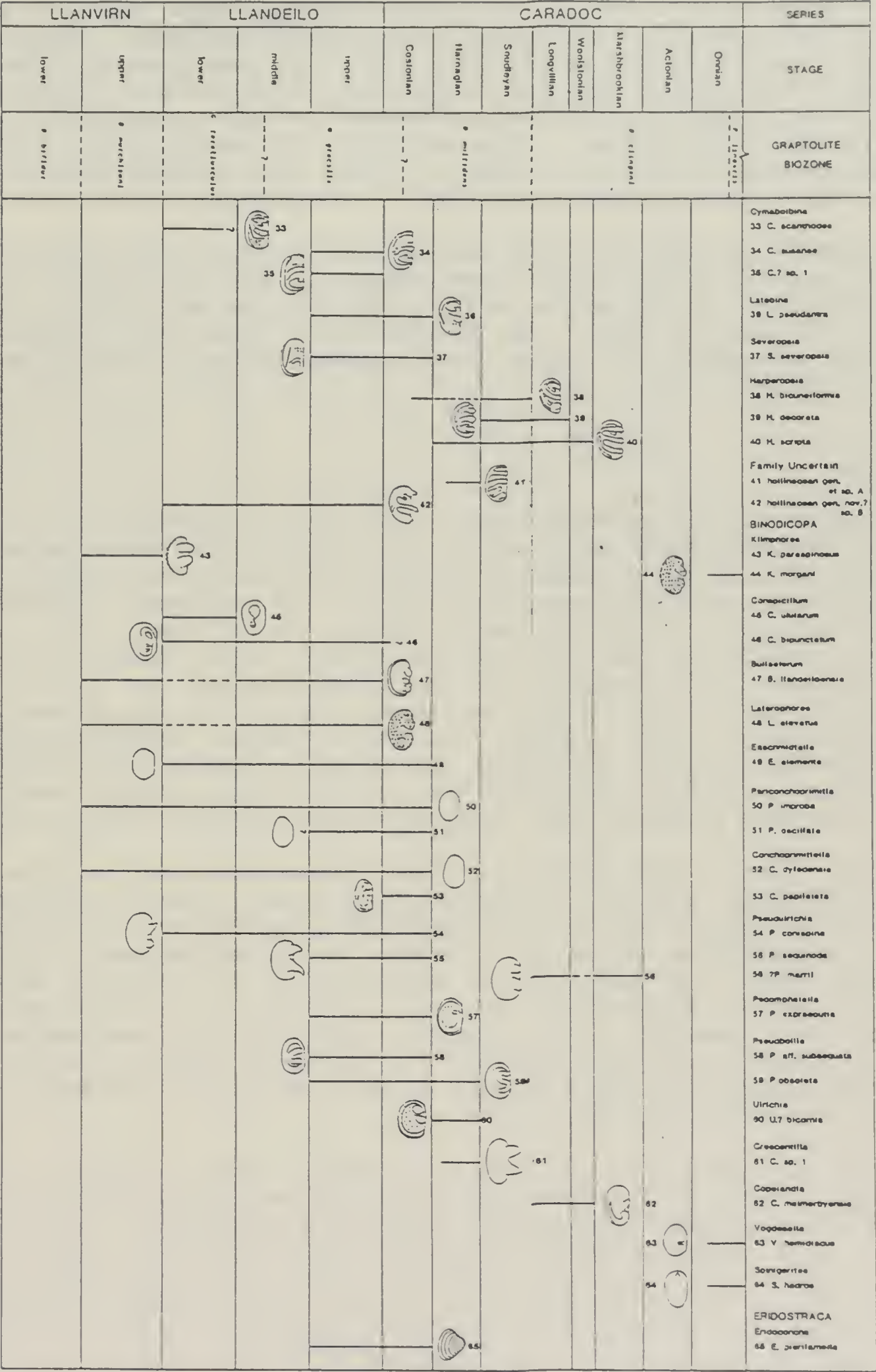
In the strongly contrasted facies of the Ordovician of the Welsh Basin, representative ostracod assemblages belong very much to the shelly associations and hardly any to the alternative basinal facies. It is significant that most of these ostracod assemblages come from Llandeilo to Ashgill age sand and carbonate dominated sequences when the contrast between shelly and graptolite facies was strongest. Compared with Baltoscandian carbonate and shale successions, in which ostracods flourished throughout the Ordovician, ostracods are virtually absent in the Arenig and most of the Llanvirn in Wales and the Welsh Borderland. The oldest known ostracod fauna of significance from the Welsh Basin comes from the upper Llanvirn Fairfach Group, near Llandeilo, Dyfed (Siveter 1978a, Jones 1986, 1987).

In spite of the fact that the distribution of British Ordovician ostracods is now known in some detail, their resolution in biostratigraphical correlation is still not as precise as one might hope for. For many of the localities in question correlation with type sections is difficult and many of the ostracod species have relatively long stratigraphic ranges (Jones 1987). The biostratigraphy of documented Llanvirn to Caradoc ostracods from Wales and England is given in Text-figs. 3, 4. Members of the suborders Palaeocopa and Binodicopa account for some 90% of the British Ordovician ostracod fauna.

Most of the Llandeilo ostracods from Britain are known from South Wales, from the carbonates occurring in an accurate belt from the type Llandeilo area westwards to Carmarthen, Narberth and Abereiddi Bay. Low diversity Llandeilo aged ostracod faunas are also known from dark graptolitic shales at Builth Wells in south central Wales and from the Shelve inlier, Shropshire. Most of the Welsh Basin taxa are geographically restricted and only permit possible local correlation. However, upper Llandeilo-basal Caradoc Pseudobollia specimens may be conspecific with material from Iowa and thus possibly provide the earliest specific level link between British and American ostracods (Jones 1986, 1987).



Text-fig. 3. Biostratigraphy of palaeocope Ostracoda from the Llanvirn, Llandeilo and Caradoc series of England and Wales (from Jones 1987): Eurychilinae (1), Ctenonotellidae (2-16) and some Tetracope (17-32). See also Text-fig. 4.



Text-fig. 4. Biostratigraphy of Ostracoda from the Llanvirn, Llandeilo and Caradoc series of England and Wales (from Jones 1987); some palaeocopes (remaining Tetradellidae (33-40), family uncertain (41, 42), binodicopes (43-64) and an eridostracan (65). See also Text-fig. 3.

In south Wales more than 20 ostracod species range into the Caradoc from the Llandeilo, though in its post-Costonian sediments ostracods are scarce. Caradoc aged ostracods are also known from Snowdonia and from Shropshire (Harnagian) and the Shelve inlier to the west (Jones 1986, 1987). Many palaeocene genera are absent in post Harnagian deposits, notably the gunnaropsines. Biostratigraphic potential and correlation using ostracods is better in the early rather than the later Caradoc, when faunas are scarce and species relatively long-ranging.

Ashgill ostracods are as yet undescribed in modern terms from Britain though abundant silicified ostracod faunas of probable Ashgill age and distinct Baltic affinity occur in the Llandeilo area and await description (Jones & Siveter in prep.; see Schallreuter & Jones 1984; Jones 1987). Conspecific material also occurs in the Portrane Limestone (Cautleyan) near Dublin, Ireland.

Silurian:

Ostracod faunas are known from all the major (shale-carbonate) marine facies of the Silurian of the Welsh Basin although, as in the Ordovician, their occurrence in deep-water graptolite shales is very rare. Both abundance and diversity increase markedly in the shallower and near-shore shelly and mixed graptolitic-shelly facies. On a broad scale, in the latter environments, many taxa of the probably mainly benthic Palaeocopa tend to show a disregard for facies boundaries and are therefore of biostratigraphical and correlative value, both locally and in some cases internationally. For example, the early Pridoli Londinia-Frostiella beyrichiacean ostracod association can be traced from areas of siltstone deposition in the Welsh Borderland into areas of contemporaneous sandstones and siltstones (Scania), shale (Pomerania) and carbonates (Baltic Sea).

Most of the British Silurian ostracod faunas have been described from the Welsh Basin, with the superfamily Beyrichiacea currently representing the most widespread and biostratigraphically significant faunal element. Other superfamilies represented include the Primitiopsacea, Hollinacea (Siveter 1985a) and Thlipsuracea, together with the families Bollidae, Aechminidae and Richinidae, plus other metacopes and platycopes. In general the 'smooth', non-palaeocopes are currently less extensively documented than the palaeocopes. The biostratigraphy of Welsh Basin Silurian ostracods is based largely on Welsh Borderland and English West Midland sequences (Text-figs. 5-7).

Like the Shelf sea benthos in general, most Silurian ostracod successions world-wide indicate that the group recovered relatively slowly during the Llandovery post-glacial eustatic transgression. In the Welsh Basin latest Ordovician and particularly early Llandovery ostracods are notably few. The Llandovery stratotype area itself has practically no known ostracod faunas and the known ostracod material from Shropshire in the northern Welsh Borderland is also relatively scarce. The late Llandovery Series Telychian Purple Shales of Shropshire are characterised by beyrichiaceans and rare, unrevised hollinaceans and primitiopsaceans. Virtually none of these Telychian taxa are definitely known to occur outside Shropshire or to cross into the Wenlock. Several undescribed taxa occur at the Llandovery/Wenlock boundary in Shropshire (e.g. see Mabillard & Aldridge 1985).

The type Wenlock, in Shropshire, has both short range species and taxa ranging throughout and sometimes beyond the Series. The dominantly mudstone part (Apedale Member) of the Coalbrookdale Formation has yielded fewer ostracod assemblages than other parts of the type Wenlock though this in part reflects sparser sampling in addition to probable relatively deeper water conditions. Both palaeocene and (the largely unrevised) non-palaeocene faunas of the type area differ significantly between the lower and upper parts of the Wenlock. Most of these known Wenlock faunas are endemic and do not, in general, assist wider correlation.

In the type areas, ostracods generally ignore the Wenlock/Ludlow series boundary, with much of the abundant and diverse upper Homeric fauna crossing into the Ludlow Elton Formation. Ostracods are more sparsely known (and sampled) from higher levels in the Gorstian. Beginning in the basal Ludfordian Lower Leintwardine Formation and continuing well into the Pridoli Series, a finely resolved, extensive international correlation of the British (mostly Welsh Borderland) palaeocene faunal succession can be demonstrated (Text-fig. 8; see Siveter 1988). For example, from the basal part of the Pridoli Series in the northern Welsh Borderland (Downton Castle Sandstone Formation) it is possible to construct an ostracod correlative chain linking benthic ostracod faunas of eastern North America and northern Europe to the graptolitic-rich, type Pridoli sequences in Bohemia via crucial 'mixed' facies in east Baltic and Polish boreholes (detailed in Siveter 1988).

Text-figs. 5-7. Represent the known ranges for 61 Silurian ostracode species in the Welsh Basin (from Siveter 1988). Based mainly on

Siveter's studies (e.g. 1974, 1978b, 1980), with their concentration on the Welsh Borderland (particularly Shropshire) and English West Midlands. For some species the records of Shaw (1969) are also incorporated. According to Shaw's (1971) correlations N. nutans,

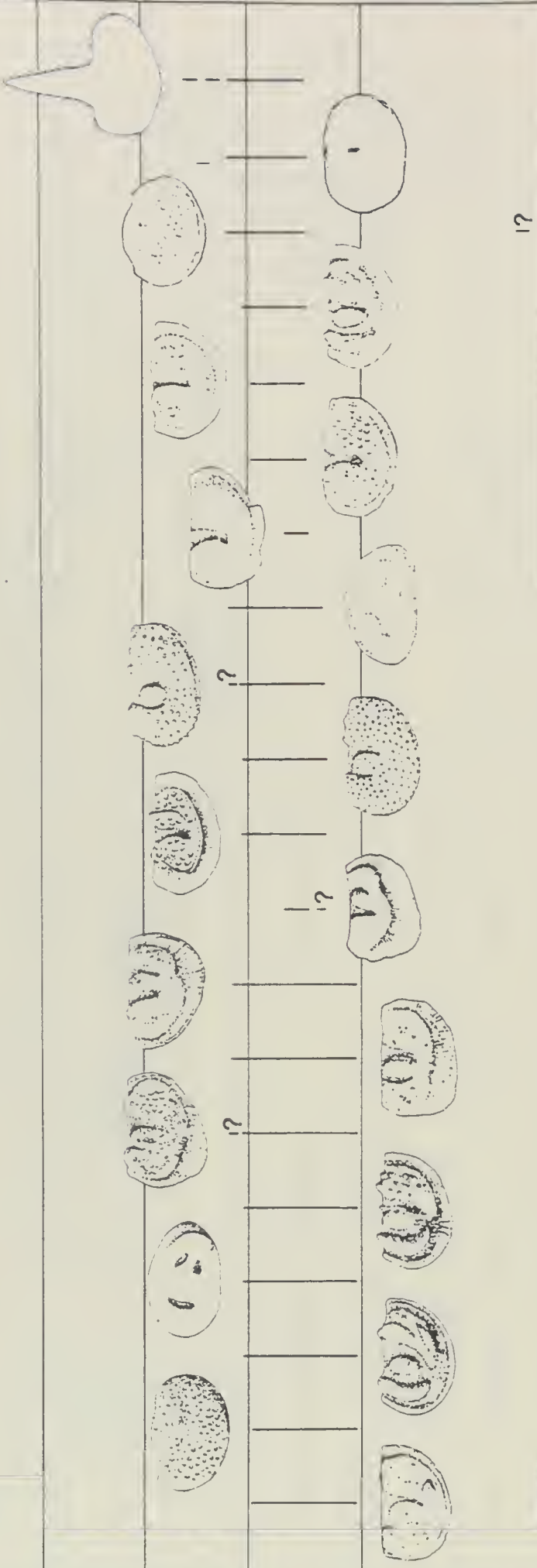
N. lauensis and N. confluens (all Text-fig. 7) each have a more extended range in the Lake District. The records of N. pustulosa and

K. wilckensiana (Text-fig. 7) are based on their occurrence in the Little Missenden Borehole. The beyrichiacean taxa given in open nomenclature are based on Siveter (MS) and are figured in Siveter 1978b (as are nearly all of the other species).

The continuous lines representing individual stratigraphical ranges have been constructed using information from 'point' sampling of scattered localities. The slight diachronism of the Much Wenlock Limestone Formation and associated strata, between the West Midlands and the Welsh Borderland, is also accounted for in the ranges. The tables naturally include an element of subjectivity where correlation or stratigraphic control are imprecisely known.

SERIES	Stages	British graptolite biozones										
PRIDOLI	Stages not yet defined	Younger graptolites unknown										
LUDLOW	Ludfordian	<i>Bohemograptus</i>										
		<i>S. leintwardinensis</i>										
	Gorstian	<i>tumescens/incipiens</i>										
		<i>L. scoticus</i>										
	Homerian	<i>N. nilssonii</i>										
		<i>M. ludensis</i>										
	Whitwell	<i>G. nassa</i>										
		<i>C. lundgreni</i>										
WENLOCK	Shenwoodian	<i>C. ellisae</i>										
		<i>C. linnarssoni</i>										
		<i>C. rigidus</i>										
		<i>M. riecktonensis</i>										
	Telychian	<i>C. murchisoni</i>										
		<i>C. centrifugus</i>										
		<i>M. crenulata</i>										
		<i>M. grilestoniensis</i>										
LLANDOVERY	Aeronian	<i>M. crispus</i>										
		<i>M. turriculatus</i>										
		<i>M. sedgwickii</i>										
		<i>M. convolutus</i>										
	Rhuddanian	<i>M. argenteus</i>										
		<i>D. magnus</i>										
		<i>M. triangulatus</i>										
		<i>C. cyphus</i>										
		<i>L. acinaces</i>										
		<i>A. alatus</i>										
		<i>O. acuminatus</i>										

SERIES	Stages	British graptolite biozones												
PRIDOLI	Stages not yet defined	Younger graptolites unknown												
LUDLOW	Ludfordian	<i>Bohemograptus</i>												
		<i>S. leintwardinensis</i>												
	Gorstian	<i>tumescens / incipiens</i>												
		<i>L. scanicus</i>												
WENLOCK	Homerian	<i>N. nilssonii</i>												
		<i>M. ludensis</i>												
	Sheinwoodian	<i>G. nassa</i>												
		<i>C. lundgreni</i>												
LLANDOVERY	Telychian	<i>C. ellesae</i>												
		<i>C. linnaeris</i>												
		<i>C. rigidus</i>												
		<i>M. riccartonensis</i>												
		<i>C. murchisoni</i>												
	Aeronian	<i>C. centrifugus</i>												
		<i>M. crenulata</i>												
		<i>M. grilestoniensis</i>												
		<i>M. crispus</i>												
		<i>M. turriculatus</i>												
Rhuddanian		<i>M. sedgwickii</i>												
		<i>M. convolutus</i>												
		<i>M. argenteus</i>												
		<i>D. magnus</i>												
		<i>M. triangulatus</i>												



SERIES	Stages	British graptolite biozones	
PRIDOLI	Stages not yet defined	Younger graptolites unknown	<i>Stielia ancon</i> ? <i>Zorotoxotis segene</i> ? <i>Lophoctenella cl. scanensis</i> ? <i>Hemstella cl. loensis</i> ? <i>Neobeyrichia nutans</i> ? <i>Stiele equestris</i> ? <i>Embryotoxotis convallis</i> ? <i>Celceribeyrichia</i> sp. nov. 1 ? <i>Neobeyrichia lauens</i> ? <i>Neobeyrichia scissa</i> ? <i>Neobeyrichia confluens</i> ? <i>Celceribeyrichia torosa</i> ? <i>Hemstella meccoyana</i> ? <i>Macrapsilon selterianum</i> ? <i>Frostiella groenwallana</i> ? <i>Londinia eriseligensis</i> ? <i>Nodibeyrichia verrucosa</i> ? <i>Londinia fissurata</i> ? <i>Frostiella bicristata</i> ? <i>Nodibeyrichia pustulosa</i> ? <i>Kloedenia wilckensiana</i> ?
		<i>Bohemograptus</i> <i>S. leintwardinensis</i>	
LUDLOW	Gorstian	<i>tumescens</i> / <i>incipiens</i> <i>L. scanicus</i> <i>N. nilsson</i>	
		<i>M. ludensis</i> <i>G. nassa</i> <i>C. lundgreni</i>	
WENLOCK	Gleedon		
	Whitwell		
	Sheinwoodian	<i>C. ellisae</i> <i>C. linnarssoni</i> <i>C. rigidus</i> <i>M. riccartonensis</i> <i>C. murchisoni</i> <i>C. centrifugus</i>	
		<i>M. crenulata</i> <i>M. griestoniensis</i> <i>M. crispus</i> <i>M. turriculatus</i>	
LLANDOVERY	Telychian	<i>M. sedgwickii</i> <i>M. convolutus</i> <i>M. argenteus</i> <i>D. magnus</i> <i>M. triangulatus</i>	
		<i>C. cyphus</i> <i>L. acinaces</i> <i>A. alatus</i> <i>O. acuminatus</i>	
	Aeronian		
	Rhuddanian		

Text-fig. 7.

Text-fig. 8. Schematic correlation in the basal Ludfordian-basal Devonian interval using a pattern of vertically successive, key ostracode faunas (from Siveter 1988). For documentation of ostracode occurrences see references given in the text. The symbols (see key) denote that a fauna is present within an individual stratigraphical unit, and are not necessarily meant to indicate exact stratigraphical positions; in most cases only the earliest occurrence of the faunas is plotted, not their complete range.

Vertical columns are not drawn to scale. The only firm time lines implied between adjacent columns are those indicated by a dotted line. Correlation agrees with that of Martinsson 1967 and Bassett et al., 1982. The base of the Pridoli with respect to the Minijs Formation is drawn after Bassett et al., 1982.

LBBM: Ludlow Bone Bed Member. PSM: Platyschisma Shale Member.
SM: Sandstone Member.

DEVONIAN SYSTEM		LUDLOW SERIES										PRIDOLI SERIES										Stages not established																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
WELSH BORDERLAND		Ludbury Fm	Temeside Shale Fm		SM Downton CS Fm	PSM LEBM ▲	Upper Whitcliffe Fm	Lower Whitcliffe Fm	Upper Leintwardine Fm	Lower Leintwardine Fm	Upper Bringswood Fm	SOUTH EAST ENGLAND		Little Missenden Borehole	BOHEMIA		MAINE		NOVA SCOTIA		PODOLIA		SCANIA		GOTLAND-HOBURG BANK		NORTHERN EAST BALTIC		CENTRAL & SOUTH EAST BALTIC		POLAND		POLISH GRAPTOLITE BIOZONES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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■ Beyrichenkalk ss fauna containing *N. pustulosa (gedanensis)* &/or *K. wickensiana*

● Beyrichenkalk ss ostracode faunal elements (e.g. *N. tuberculata*)

▲ fauna with *F. groenvaliana (leblensis)* &/or *L. arisaigensis*

★ fauna with *N. regnans*

◆ fauna with *N. laevis* &/or *N. scissa*

▼ fauna with *N. nutans* &/or *N. pulcherrima*

OSTRACOD PALAEOECOLOGY

Certainly by Silurian times ostracods had occupied most of the main habitats and taken up most of the lifestyles known from modern ostracods (Siveter 1984). Depth and salinity were probably the major controls on the distribution of lower Palaeozoic ostracods. The field localities selected for sampling have partly been chosen in order to demonstrate a range of environments and lifestyles for the Ordovician-Silurian ostracods of the Welsh Basin.

Most of the Silurian and Ordovician ostracods to be collected at the various localities were probably benthic, crawling and swimming as a part of generally diverse and abundant faunas in relatively shallow, shelf and upper shelf slope clastic and carbonate environments (e.g. Stops 1, 3-10, 12, 14-16). The origin of morphologically specialised pelagic ostracod faunas may be traced (Siveter *et al.* 1987) to somewhat deeper, offshore (shelf slope) marine environments and had occurred certainly by the Silurian, though such faunas are relatively rare (Stop 13).

The Ordovician and Silurian ostracods of the Welsh Basin are all marine except perhaps for some late Silurian (Pridoli) faunas (Stop 10), which possibly represent a transition towards reduced salinity (brackish water?) assemblages. Freshwater and truly deep-sea ostracod faunas are not known from the Welsh Basin.

LOCALITIES

The sequence of localities follows the field programme outlined in the 'Introduction' above. Localities in the Ordovician and Silurian of the northern Welsh Borderland, in the Shelve, Caer Caradoc, Wenlock and Ludlow districts, are described first (Stops 1-12). A traverse across the Welsh Basin examines offshore pelagic faunas in the Silurian (Stop 13), prior to sampling for silicified faunas in the Ordovician of South Wales (Stops 14-16).

Access to several of the localities is possible only by obtaining prior permission from the land owners. Visitors should ensure that they do not engage in casual collecting at any of the localities, many of which are, typically for the Welsh Basin, small and potentially vulnerable.

The ostracod faunal lists are not full lists; rather they are given to indicate (in most cases) the more distinctive or common taxa. Many important faunal elements are currently being revised (D. Siveter; R.F. Lundin; Lee Peterson) and await publication. An asterisk (*) next to an ostracod name in the faunal lists indicates that it is the type locality for the species.

STOP 1: HOPE BOWDLER, CARADOC DISTRICT

Exposure on S side of B 4371 road, about 180m WNW of Hope Bowdler Church, Shropshire; SO 4739 9244.

Smeathen Wood Formation; Harnagian Stage, Caradoc Series, Ordovician. Mould material.

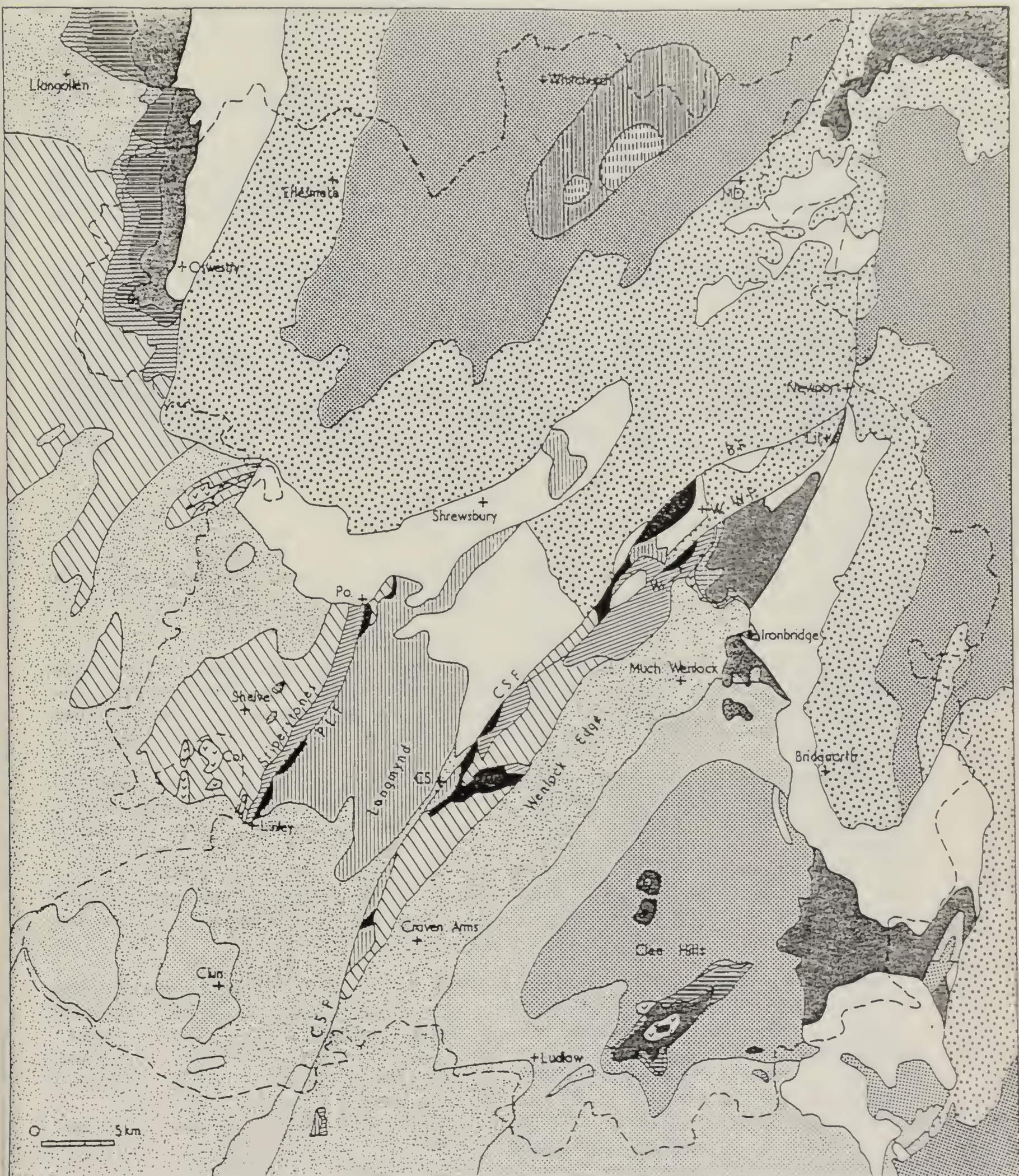
To the east of the Long Mynd and on the eastern side of the Church Stretton fault complex the Ordovician outcrops in two areas of the Caradoc district of east Shropshire: to the northeast and southwest respectively of an area of Pre-Cambrian between Church Stretton and Hope Bowdler (Greig et al. 1968). Minor lithostratigraphical differences occur between the two areas. Stop 7 occurs in the more southerly outcrop as does, in the Onny Valley some 9km to the SSW, the type Caradoc sequence. It should also be noted that the Ordovician sequence in the Caer Caradoc-Onny Valley area is completely different from the Ordovician succession in the Shelve inlier, to the west of the Long Mynd (see under Stop 11).

At the classic roadside locality at Hope Bowdler the Smeathen Wood Formation ('Harnage Shales' of traditional literature) rests, with a basal 20-30cm conglomerate horizon, on Pre-Cambrian Uriconian volcanics. The Coston Formation, the basal Ordovician (Caradoc) unit in the area is absent, having been overlapped. Further evidence of the unconformable relationship occurs at a quarry 1km to the NE on Hazler Hill, where a fossiliferous, ostracod-bearing sandy mudstone of the Smeathen Wood Formation forms Neptunean fissure infills a few centimeters thick within the Uriconian basic volcanics (see Greig et al. 1968).

At Stop 7 the Smeathen Wood Formation comprises friable brown shales and mudstones with a diverse fauna of chiefly brachiopods, bryozoans, trilobite fragments (trinucleids) and ostracods. Large and well preserved specimens of the gunnaropsine Harperopsis scripta (see Jones & Siveter 1983) are relatively common. The binodicope Crescentilla (Jones 1987,

SYSTEM	SERIES	STAGES	LITHOSTRATIGRAPHY			
SILURIAN	PRIDOLI	Stages not yet defined	Ledbury Formation Temeside Shales Formation Downton Castle Sandstone Fm { Sandstone Mbr. Platyschisma S.Mbr. Ludlow B.B. Mbr.			
	LUDLOW	Ludfordian	Upper Whitcliffe Formation Lower Whitcliffe Formation Upper Leintwardine Formation Lower Leintwardine Formation			
		Gorstian	Upper Bringewood Formation Lower Bringewood Formation Upper Elton Formation Lower Elton Formation			
	WENLOCK	Homerian	Much Wenlock Limestone Formation			
		Sheinwoodian	Coalbrookdale Formation { Farley Member Apedale Member Buildwas Formation			
	LLANDOVERY	Telychian	Purple Shales			
		Aeronian	Pentamerus Beds Kenley Grit			
	ORDOVICIAN	CARADOC	Onnian	Onny Shale Formation		
			Actonian	Acton Scott Formation		
Marshbrookian			Cheney Longville Formation			
Woolstonian			Alternata Limestone Formation			
Longvillian			Horderley Sandstone Formation			
Soudleyan			Glenburrell Formation			
Harnagian			Smeathen Wood Formation			
Costonian			Coston Formation			
TREMADOC			Shineton Shales			
CAMBRIAN		MERIONETH	Stages not yet defined	Bentleyford Shales		
	Shoot Rough Road Shales					
	ST. DAVID'S	Upper Comley Group				
	COMLEY	Lower Comley Limestone Lower Comley Sandstone Wrekin Quartzite				
PRE-CAMBRIAN	Series not yet defined		Longmyndian	Wentnor Group	Bridges Formation Bayston-Oakwood Formation	
				Stretton Group	Portway Formation Lightspout Formation Synalds Formation Burway Formation Stretton Shale Formation	
			Uriconian Volcanics			

Text-fig. 9. Generalised stratigraphical succession of the Pre-Cambrian and Lower Palaeozoic of Shropshire.



No differentiation is made between normal and faulted boundaries

JURASSIC		Middle Lias	CARBONIFEROUS		Lower Middle Coal Measures	ORDOVICIAN		CAMBRIAN
		Lower Lias			"Millstone Grit"			Longmyndian
TRIASSIC		"Keuper"	DEVONIAN		Carboniferous Limestone	PRE-CAMBRIAN		Uniconian
		"Bunter"			Old Red Sandstone			Rushmore Schist
PERMO-TRIASSIC		Upper Coal Measures	SILURIAN		Downtonian			
CARBONIFEROUS					Marine Silurian			

MD: Market Drayton, Lil: Lilleshal, W: Wellington, Po: Pontesbury, Wr: Wrekin, Co: Corndon, CS: Church Stretton.
CSF: Church Stretton Fault, BF: Brockton Fault, WF: Wrekin Fault, PLF: Pontesford Linley Fault.

Text-fig. 10. The geology of Shropshire, northern Welsh Borderland (from Toghill & Chell 1984).

28
p. 85) is also recorded locally from the Smeathen Wood Formation but is not known from this locality.

Hope Bowdler is a site of special scientific interest; hammering and collecting is forbidden in the vicinity of the unconformity itself. It is recommended that the Smeathen Wood Formation be collected from loose material.

Ostracod fauna: See Siveter 1978a; Jones & Siveter 1983; Jones 1984, 1986 (loc. 37), 1987.

Duringia triformosa Jones, 1984; Harperopsis scripta (Harper, 1947); hollinacean gen. et sp. nov. A (of Jones 1986); Ogmoopsis (Quadridigitalis) siveteri Jones, 1986; Sigmoopsis (Sigmoopsis) duftonensis (Reed, 1910); Varilatella (Varilatella) bulbosa Jones, 1986*; Vitella fecunda Siveter, 1983; Ulrichia ? bicornis (Jones, 1855).

STOP 2: WENLOCK EDGE

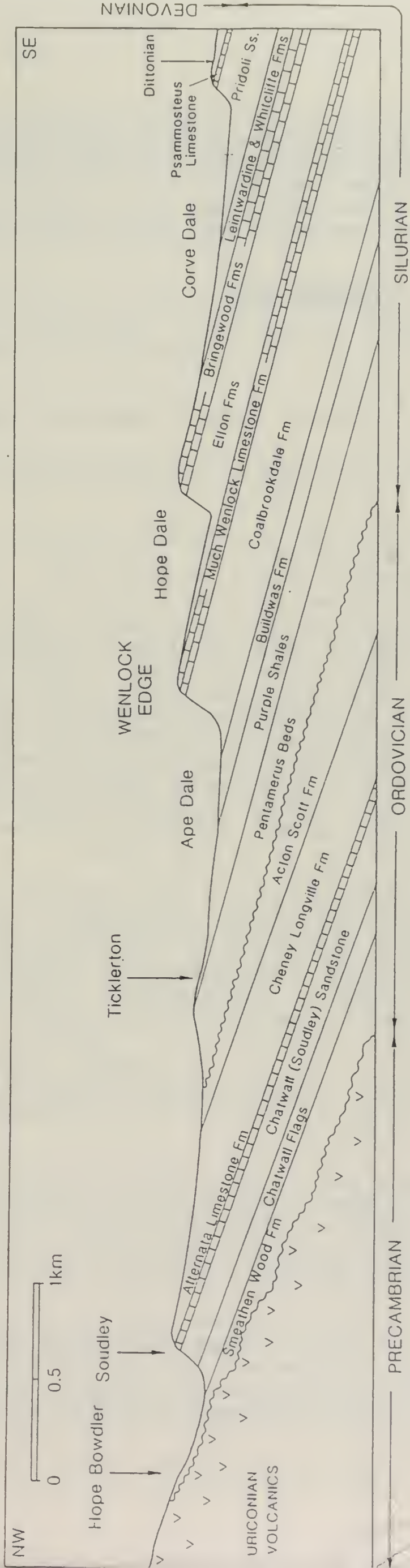
W side of B4371 road, about 4.5km SW of Much Wenlock, Shropshire SO 574 967.

This vantage point, on the Much Wenlock Limestone Formation, affords magnificent views of the north Shropshire countryside and demonstrates the close relationship between geology, topography and scenery across an area boasting a Pre-Cambrian through to Carboniferous sequence (Text-fig. 11).

Immediately to the west, much of the valley of Ape Dale is formed in the relatively soft, dominantly shaley lower Silurian (Kenley Grit, Pentamerus Beds, Purple Shale, Buildwas Formation, Coalbrookdale Formation). In the distance to the west the line of late Pre-Cambrian Uriconian volcanics stand proud as the whale-back hills of Ragleth Hill, Caer Caradoc and The Lawley. Some 20km NE along strike, on a continuation of the line of Church Stretton fault complex, the similarly dated and shaped Wrekin Hill is visible.

Westwards beyond Caer Caradoc and The Lawley the NE-SW trending late Pre-Cambrian clastic sequence of the Long Mynd forms a skyline feature rising to 517m, the intervening ground being occupied by the flat, Silurian and glacial drift floored Church Stretton rift valley. Eastwards from Caer Caradoc an attenuated succession of Cambrian and Ordovician (Caradoc Series) sediments dip eastwards to underlie the Silurian in Ape Dale. The NE-SW ridge of Hoar Edge, flanking the eastern side of The Lawley is formed of the basal Caradoc Hoar Edge Grit.

To the east of Wenlock Edge itself, the gentle easterly regional dip is continued through the sequence of upper Silurian to Devonian sediments in which several horizons forming prominent scarp features parallel to Wenlock Edge alternate with softer lithologies forming intervening vales. Thus, the Aymestry Limestone (Upper Bringewood Formation, Ludlow Series) form a fairly continuous scarp between the shales of the Elton formations, which occupy Hopedale and the dip slope of Wenlock Edge, and the upper Ludlow siltstones and Old Red Sandstone facies Pridoli sandstones of Corvedale. Eastwards, basal Devonian sandstones above the Psammosteus limestone form a scarp encircling the Old Red Sandstone Plateau dominated by the Brown Clee (540m) and Titerstone Clee (533m) summits, both of which are topped by Carboniferous limestones, sandstones, Coal Measures and basalts.



Text-fig. 11. Generalised cross section from Hope Bowdler to Corve Dale, showing the relationship between geology and topography in the Wenlock Edge area (modified from Toghiani & Chell 1984).

The two scarps produced by the Much Wenlock Limestone Formation and Aymestry Limestone respectively can be traced from the area of Wenlock Edge southward into the horse-shoe shaped outcrop of the Silurian Ludlow anticline. The axis of the fold is centred on Ludlow itself and its core, in the Vale of Wigmore, consists of soft Coalbrookdale Formation shales.

STOP 3: COATES QUARRY, WENLOCK EDGE

Quarry on N side of B4371 road, about 1.7km SW of Much Wenlock, Shropshire; SO 6045 9935.

Much Wenlock Limestone Formation; Homeric Stage, Wenlock Series, Silurian, Washed material.

Access is only by prior arrangement with E.C.C. quarries.

Coates Quarry is situated in the 'reef area' which occupies the northern one-third (between Easthope and Ironbridge) of the outcrop of the Much Wenlock Limestone Formation along Wenlock Edge (Shergold & Bassett 1970, fig. 8; Scoffin 1972; Bassett *et al.* 1975). Reef limestones are not developed in the Formation to the southwest of Easthope, either along Wenlock Edge (to the Onny Valley near Craven Arms) or in the Leintwardine or Ludlow districts of the Ludlow anticline. These areas are thought to have occupied a slightly more basinal position and hence lay in somewhat deeper water than the patch reefs of the late Wenlock shelf which are found from Walsall and Dudley in the West Midlands of England and, via the south Welsh Borderland inliers in the Malverns, Woolhope and May Hill, to Usk in South Wales (Bassett 1974). At coeval horizons some 30-40km to the west of Wenlock Edge dark graptolitic shales occur in the presumed basinal parts of the Welsh Basin in areas such as the Long Mountain.

The reefs are bioherms consisting mainly of a wide variety of colonial tabulate (Heliolites, Favosites, Halysites, Thecia) and rugose (Arachnophyllum) corals, stromatoporoids (Stromatopora), calcareous algae (Girvanella, Rothpletzella, Wetheredella) and bryozoans (Hallopora, Rhombopora, Fistulipora, Fenestella) fulfilling the role of framebuilders and binders. Many non-colonial organisms such as crinoids (e.g. Mastigocrinites), gastropods (e.g. Poleumita), trilobites (e.g. Calymene, Dalmanites) brachiopods (e.g. Leptaena, Atrypa, Strophonella, Eospirifer, Howellella, Sphaerirhynchia) and ostracods lived in and around the reefs and together with fragmented reef organisms and carbonate mud formed the reef matrix.

The smaller, ovoid reefs average 3m high x 12m wide; the larger reefs are generally much more irregularly developed. The reef margins interdigitate with bedded inter-reef limestones which embrace a range of biomicrite and biosparite lithofacies including crinoidal, nodular and tabular limestones; off reef talus sometimes occur.

The Wenlock reefs, which occur along Wenlock Edge predominantly in the upper half of the Much Wenlock Limestone Formation, probably developed in shallow (maximum 30m), oxygenated, but relatively calm waters in which their growth rate and pattern was determined by local factors of mud supply and where the occurrence of bentonites can often be correlated with reef demise (Scoffin 1972).

As seen in thin section ostracods are commonly present in the bedded limestones but are virtually impossible to extract isolated. Best yields are obtained by sampling the shaly and bentonitic horizons.

Ostracod fauna: See Siveter 1974; 1980 (loc. 53).

Beyrichia clausa Jones & Holl, 1886; Beyrichia sp. nov.; Strepula concentrica Jones & Holl, 1886; beyrichiacean gen. nov. F (of Siveter 1978b); Thlipsura corpulenta Jones & Holl, 1869; 'Bairdiocypris' phillipsianus (Jones & Holl, 1869).

STOP 4: HARLEY BROOK, APE DALE

S bank of Harley Brook 230m NE of the Feathers Inn, about 2.5km NW of Much Wenlock, Shropshire; SJ 6010 0116.

Buildwas Formation; Sheinwoodian Stage, Wenlock Series, Silurian. Washed samples.

The Buildwas Formation can be traced from its eponymous village on the River Severn, southwestwards along the valley of Ape Dale at the foot of the 30km long Wenlock Edge (Bassett et al. 1975). At Stop 4 several meters of typical Buildwas Formation lithology is well displayed, comprising friable and blocky buff to olive-green and grey shelly mudstones and siltstones with occasional but well developed calcareous nodular horizons. Comminuted shell debris and bentonitic bands also characterise the Formation, which contains a diverse fauna of especially brachiopods such as Dicoelosia biloba, Isorthis, Atrypa, Atrypina, Eoplectodonta and Resserella.

The quite diverse ostracod fauna of the Buildwas Formation is dominated by non-palaeocopes; beyrichiacean species are rare. Siveter (1978b) documented the changes in the ostracod fauna between the Llandovery and Wenlock Series of the area. Mabillard & Aldridge (1985) charted in detail the microfaunal and microfloral biostratigraphy across the base of the Wenlock Series (into the Buildwas Formation) at its stratotype boundary at Leasows (SO 5688 9839) in Hughley Brook in Ape Dale, some 4km SW of Stop 4.

Ostracod fauna: See Siveter 1974, 1978b, 1980, 1988; Peterson & Lundin 1974; Mabillard & Aldridge 1985.

Bollia bicollina Jones & Holl, 1886; Craspedobolbina interrupta (Jones, 1887); Parulrichia diversa (Jones & Holl, 1886); Longiscella grandis (Jones & Holl, 1869); Rectella sp.; Microcheilinella sp.; Neckajatia subquadrata (Jones, 1887); Thlipsura martinssoni Peterson & Lundin, 1974; 'Macrocypris' vinei (Jones, 1887).

STOP 5: HARLEY HILL QUARRY, WENLOCK EDGE

Small disused quarry on N side of A 458 road, crest of hill, about 1.2km NW of Much Wenlock, Shropshire; SJ 6110 0034.

Much Wenlock Limestone Formation; Homerician Stage, Wenlock Series; Silurian. Washed samples.

This locality occurs in the reef tract of the Much Wenlock Limestone Formation (for geological setting see under Stop 3) and consists of what Shergold & Bassett (1970, p.122, fig. 9) termed 'bluestone lithofacies'. Beds (5-25cm) of blue-grey, muddy, crinoidal biomicrite having irregularly undulating bedding surfaces, together with layers of nodular limestone, alternate with thinner bands of grey shale. Fossils, including samples of ostracods are best sought from the shale horizons.

The quarry is situated at the top of a reasonably continuous section up Harley Hill, which demonstrates the upward gradation (over some 3m) from the highest shales and impersistent nodular limestones of the Farley Member of the Coalbrookdale Formation into the Much Wenlock Limestone Formation. The base of the latter Formation is recognised at the occurrence of the first regularly bedded limestones above which layers of discrete nodules are scarce (Shergold & Bassett 1970, fig. 10; Bassett et al. 1975). Most of the well exposed, top part of the Harley Hill road section lies in the Bluestone Lithofacies of the Much Wenlock Limestone Formation and any of the shale partings are likely candidates for sampling for ostracods (Siveter 1980, loc. 48: 'Harley Hill Road'). A small bioherm occurs high in the section on the N side of the road just past the telegraph pole.

Ostracod fauna: See Siveter 1974, 1978b, 1980 (loc. 51).

Beyrichia clausa Jones & Holl, 1886; Beyrichia sp. nov.; Bolbiprimitia sp.; Garniella sp. nov.; Loutriella sp. nov.; Gongylostonyx exaggeratus Siveter, 1980*; Strepula concentrica Jones & Holl, 1886; Sarmatotoxotis phracta Siveter, 1980; beyrichiacean gen. nov. F (of Siveter 1978b); Thlipsura corpulenta Jones & Holl, 1869; Microcheilinella sp.; 'Bairdiocypris' phillipsianus (Jones & Holl, 1869); 'Longiscula' smithii (Jones, 1887).

STOP 6: UPPER MILLICHOPE, NEAR HOPE DALE

Stream section, about 600m NW of Upper Millichope, near Hope Dale, Shropshire; SO 5185 8987.

Lower Elton Formation; Gorstian Stage, Ludlow Series, Silurian. Washed material.

Special permission has been given to allow access for the Symposium field party to this locality; collecting is normally forbidden.

The Lower Elton Formation of the area, immediately E of Wenlock Edge, consists of about 30m of dominantly olive-grey or brown muddy or calcareous siltstones, sometimes alternating in the lower part of the sequence with limestone layers (Shergold & Bassett 1970). The mudstones and siltstones commonly have an extremely rich, fragmented and disarticulated shell content and also contain, in the upper part of the Lower Elton Formation, argillaceous limestone modules.

In the Millichope area the mudstones are flaggy bedded. The diverse fauna includes brachiopods (e.g. Dicoelosia, Skenidioides, Craniops) trilobites (Dalmanites) and ostracods. Many of the faunal elements are known from the underlying Wenlock Series. See also Stop 7.

Ostracod fauna: see Siveter 1974, 1978b, 1980, 1988; Shergold & Shirley 1968.

Amphitoxotis repanda Siveter, 1980; Beyrichia clausa ? Jones & Holl, 1886; Tinotoxotis velivola Siveter, 1980; Aechmina cuspidata Jones & Holl, 1869; Primitiopsis valida (Jones & Holl, 1886); Thlipsura corpulenta Jones & Holl, 1869; Octonaria octoformis (Jones, 1887); Neckajatia subquadrata (Jones, 1887); 'Primitia' variolata (Jones & Holl, 1865).

STOP 7: SHADWELL ROCK QUARRY, MUCH WENLOCK

Top of N face of quarry, E of B4378 road, 1km N of Much Wenlock, Shropshire; SJ 6255 0090.

Lower Elton Formation; Gorstian Stage, Ludlow Series, Silurian. Washed material.

This locality exposes an excellent sequence through the upper part of the Much Wenlock Limestone Formation and into the Lower Elton Formation. Small bioherms are sometimes exposed in the working faces of the limestone part of the quarry. The contact between the two formations is reasonably sharp and is drawn between the sequence of alternating limestone and siltstone layers (basal Elton) and the more obviously bedded limestones (top Wenlock). Most of the Lower Elton Formation exposed consists of shelly rich, olive-grey siltstones in which a diverse fauna of brachiopods (e.g. Atrypa and large strophomenaceans), corals, trilobites, gastropods and stomatoporoids may be found. See also Stop 6.

Ostracod fauna: See Siveter 1978b, 1980.

Amphitoxotis repanda Siveter, 1980; Beyrichia clausa Jones & Holl, 1886; Sleia pauperata (Jones, 1869); Sleia trodlodytophila Martinsson, 1962; Strepula concentrica Jones & Holl, 1886; Tinotoxotis velivola Siveter, 1980; Thlipsura corpulenta Jones & Holl, 1869; 'Longiscula' smithii ? (Jones, 1887); Microcheilinella sp.; 'Primitia' variolata (Jones & Holl, 1865); Neckajatia subquadrata (Jones, 1887).

STOP 8: ACKLANDS COPPICE, NEAR TICK WOOD

Section along old railway track, NW side of Acklands Coppice, between Buildwas and Much Wenlock, Shropshire; SJ 6379 0269.

Farley Member, Coalbrookdale Formation; Homeric Stage, Wenlock Series, Silurian. Washed material.

The Tickwood Beds of Davidson & Maw (1881) were renamed as the Farley Member of the Coalbrookdale Formation in the reappraisal of the type Wenlock Series by Bassett et al. (1975). The Farley Member outcrops high in the scarp face along the whole of Benthall Edge and Wenlock Edge; its transitional base, from the mudrock dominated Apedale Member of the Coalbrookdale Formation, is best seen on Harley Hill (see under Stop 5).

The Farley Member is essentially an alternating sequence of grey shaly mudstones and thin bands of limestone nodules. The mudstones have yielded most ostracods.

Ostracod fauna: See Siveter 1974, 1978b, 1980, 1988.

Amphitoxotis repanda Siveter, 1980; Gongylostonyx exaggeratus Siveter, 1980; Loutriella sp. nov.; Strepula concentrica Jones & Holl, 1886; Sleia pauperata (Jones, 1869); Sarmatotoxotis phracta Siveter, 1980; Tinotoxotis praegnans Siveter, 1980; beyrichiacean gen. nov. F (of Siveter 1980); Thlipsura corpulenta Jones & Holl, 1869; Microcheilinella sp.; 'Primitia' variolata Jones & Holl, 1869; 'Bairdiocypris' phillipsianus (Jones & Holl, 1869).

STOP 9: LINCOLN HILL, IRONBRIDGE

Steeply dipping bedding planes at old workings on SW side of hill about 250m N of River Severn at Ironbridge, Shropshire; SJ 6693 0381.

Much Wenlock Limestone Formation; Homeric Stage, Wenlock Series, Silurian. Washed material.

"This locality is exactly behind the Swan Hotel, Ironbridge" said Smith in his 1881 (see also 1892) description of Welsh Borderland Silurian localities from which he obtained "Bivalved Entomostraca" to send to T.R. Jones for identification. The Swan Inn exists today, and the steeply dipping, weathered bedding planes of the old limestone workings of Lincoln Hill, form one of the richest sources of British Silurian ostracods.

The extraction of limestone, here originally obtained open cast and subsequently from underground workings, benefited both industry and agriculture in this the birthplace area of the worlds 18th-19th century industrial revolution. Lincoln Hill ridge, the northeasterly most continuation of the Much Wenlock Limestone Formation scarp which forms Wenlock Edge and Benthall Edge across the River Severn to the southwest, is flanked to the east by the Carboniferous valley of Coalbrookdale and to the west by Ironbridge town itself. Benthall Hall (SJ 657 026), on top of Benthall Edge, was the home of George Maw (see 'History of ostracod studies' above) until his retirement in 1886.

At Stop 9 fossils are best obtained from samples collected from shaley partings and weathered bedding planes. This locality has yielded abundant palaeocope and non-palaeocope faunas. Macrofossils are equally very diverse and include many of the 70 or so brachiopod species recorded from the Formation (e.g. Meristina, Atrypa, Eospirifer, Strophonella, Howellella, Cyrtia, Gypidula, Resserella, Isorthis, Sphaerirhynchia; see Bassett 1970-74, 1981), together with rugose and tabulate corals, bryozoa, trilobites and gastropods.

Ostracod fauna: See Siveter 1974, 1978b, 1980 (loc. 49), 1988; Lundin & Peterson 1975.

Amphitoxotis repanda Siveter, 1980*; Beyrichia clausa Jones & Holl, 1886; Bolbiprimitia sp. nov.; Garniella concinna (Jones & Holl, 1886); Garniella sp. nov.; Gongylostonyx exaggeratus Siveter, 1980; Sleia pauperata (Jones, 1869); Sarmatotoxotis phracta Siveter, 1980*;

Strepula concentrica Jones & Holl, 1886; Tinotoxotis velivola Siveter, 1980*; beyrichiacean gen. nov. F (of Siveter 1978b); Thlipsura corpulenta Jones & Holl, 1869; Silensis longus Abushik, 1971; 'Longiscula' smithii (Jones, 1887); 'Bairdiocypris' phillipsianus (Jones & Holl, 1869); 'Macrocypris' vinei (Jones, 1887).

STOP 10: LUDFORD LANE, LUDLOW

N side of Ludford Lane (= 'Whitcliffe Road') about 70-90m W of junction with A49 road, Ludlow, Shropshire; SO 5119 7413.

Upper Whitcliffe Formation, Ludfordian Stage, Ludlow Series and Ludlow Bone Bed Member and Platyschisma Shale Member, Downton Castle Sandstone Formation, Pridoli Series, Silurian. Mould material.

This classic locality (Murchison 1839) has international geological importance as the section traditionally considered as the Siluro-Devonian boundary and also formerly proposed as a possible (British) stratotype section for the base of the fourth series of the Silurian (at the base of the Ludlow Bone Bed and Downton 'Series'; Bassett et al. 1982). From Ludford Corner (junction of Ludford Lane with the A49), for some 150m on the sides of Ludford Lane, an almost continuous exposure exists through approximately 5m of beds embracing the topmost part of the Ludlow Series Whitcliffe Formation and the lower part of the Downton Castle Sandstone Formation. Based on a complex chain of correlation, mainly involving ostracods, the base of the 'Downton' can now be accurately correlated across to North America (e.g. Nova Scotia and Maine) and, in the opposite direction, via Baltic marine sequences to the base of the officially designated fourth series of the Silurian, the Pridoli Series, in the Barrandian Basin of Czechoslovakia (Siveter 1978b, 1988; Bassett et al. 1982).

The Upper Whitcliffe Formation at this locality consists of olive calcareous siltstones with a reasonably diverse marine invertebrate fauna which particularly includes articulate brachiopods (e.g. Howellella, Salopina, Protochonetes) and also one of the rare (but the most common and characteristic of the) type Upper Whitcliffe Formation ostracod species, Calcaribeyrichia torosa. Beginning at the base of the Ludlow Bone Bed Member, at the base of the Downton Castle Sandstone Formation, and continuing upwards through the Platyschisma Member and into the Sandstone Member, a faunal change sees the loss of abundant articulate brachiopods and the introduction of the inarticulate Lingula minima together with a new suite of biostratigraphically important beyrichiacean ostracods (including F. groenvalliana, L. arisaigensis and N. verrucosa) scattered throughout the sequence. Associates of these ostracods characteristically include bivalves (Modiolopsis complanatus) and gastropods (Turbocheilus [Platyschisma] heliutes; Loxonema sp.) together with eurypterid and fish remains and fragments of early plants such as Pachytheca. Thus, above the Ludlow Bone Bed Member forms typical of the Upper Whitcliffe Formation are virtually absent from the remainder of the Downton Castle Sandstone Formation (see Bassett et al. 1982 for full details).

The Ludlow Bone Bed Member (about 0.2m), occupying the distinctive cleft in the section, consists of laminated and lenticular bedded siltstones embracing thin and discontinuous, dark vertebrate sands. These bone beds (of which the basal bone bed is the Ludlow Bone Bed s.s.) consist essentially of agnathan thelodont (e.g. Logania ludlowensis and

Thelodus parvidens) and acanthodian scales. The Platyschisma Shale Member (up to 2m) comprises unlaminate to laminated mudstones and shales with subordinate siltstones; the overlying Sandstone Member (just present at the top of the section) consists mostly of thick, fine-grained sandstones.

Ludford Corner is a designated site of special scientific interest. Hammering at the locality is strictly forbidden. Collections (of loose material if possible) may be obtained from the section in Ludford Lane where great care must be taken not to over collect.

Ostracod fauna: See Martinsson 1963, 1967; Shaw 1969; Siveter 1974, 1978b, 1980 (locs 69, 73, 74), 1988; Bassett et al. 1982.

Platyschisma Member: Frostiella groenvalliana Martinsson, 1963; Londinia arisaigensis (Copeland, 1964); Londinia fissurata Shaw, 1969; Nodibeyrichia verrucosa Shaw, 1969.

Ludlow Bone Bed Member: Calcaribeyrichia torosa (Jones, 1855); Frostiella groenvalliana Martinsson, 1963; Londinia arisaigensis (Copeland, 1964); Londinia fissurata Shaw, 1969; Lophoctenella sp.; Nodibeyrichia verrucosa Shaw, 1969.

Upper Whitcliffe Formation: Calcaribeyrichia torosa Jones, 1855. The beyrichiaceous listed above are accompanied throughout by rare, indeterminate, smooth non-palaeocopes.

STOP 11: RORRINGTON, SHELVE INLIER

Small field exposure, about 90m S of Rorrington Hall, inside gate on footpath to Kington, Rorrington, Shropshire; SJ 2984 0062.

Spywood Member, Chirbury Formation; Costonian Stage, Caradoc Series, Ordovician. Mould material.

The two most important areas of Ordovician rock in the Welsh Borderland are the Shelve inlier (e.g. Stop 11) and the area around Caer Caradoc (see Stop 1) to the west and east respectively of the Long Mynd topographic high. The Ordovician successions of the two areas are very different. In the Caradoc area less than 1000m of dominantly shallow water shelf deposits (sandstones, limestones) occur and are of entirely Caradoc age; sequences show many facies changes and stratigraphical breaks. The Shelve inlier (see Whittard 1979) now over 4000m of Arenig-Caradoc aged deposits, mainly shales and siltstones with a mixed graptolitic and shelly fauna. Volcanic rocks, of Llanvirn and Caradoc age, also occur in the Shelve inlier.

The ostracod fauna at Stop 11 is dominated by Piretopsis salopiensis and particularly Harperopsis bicuneiformis; other species are comparatively scarce.

Ostracod fauna: See Siveter 1978a; Jones 1986 (loc. 31), Jones 1987.

Harperopsis bicuneiformis (Harper, 1947)*, Histina xanios Jones, 1986; Ogmoopsis (Quadridigitalis) siveteri Jones, 1986; Ogmoopsis ? sp. nov. 1 (of Jones 1986); Piretopsis (Protallinnella) salopiensis (Harper, 1947)*; Varilatella (Varilatella) bulbosa Jones, 1986; Varilatella (Varilatella) dissita (Schallreuter & Siveter, 1983).

STOP 12: BENGRY TRACK, AYMESTREY

Exposure at E end of track, about 200m W of Crown Inn at Aymestrey, Hereford & Worcester; SO 4228 6544.

Upper Leintwardine Formation; Ludfordian Stage, Ludlow Series, Silurian. Mould material.

The irregularly bedded, grey-olive siltstones contain a rich ostracod fauna, consisting almost entirely of beyrichiaceans. Most common is the largest British palaeocope species, Nodibeyrichia lauensis, an index fossil for the Leintwardine beds in the Welsh Borderland and occurring at similar horizons in the Baltic and Podolia (Text-fig. 8). The ostracod valves are concentrated most in the decalcified so-called 'gingerbread' bands. Characteristic macrofossils in the Upper Leintwardine Formation at Stop 12 include the brachiopod Aegiria and the trilobite Calymene.

The type 'Aymestry Limestone' Quarry (Murchison 1939) (=upper Bringewood Formation) lies adjacent to the riverside path just west of the Crown Inn and topographically directly below the Upper Leintwardine Formation of Bengry Track (Lawson 1983).

Ostracod fauna: see Siveter 1974, 1978b, 1980 (loc. 63), 1982a, 1988.

Atterdagia versiculus Siveter, 1980; Calcaribeyrichia sp. nov.; Embryotoxotis convallis Siveter, 1980; Hemsiella ? sp. nov.; Neobeyrichia confluens Shaw, 1971; Neobeyrichia lauensis (Kiesow, 1888); Neobeyrichia scissa Martinsson, 1962; Sleia equestris Martinsson, 1962; Lophoctenella cf. L. scanensis (Kolmodin, 1869).

STOP 13: FRIENDS MEETING HOUSE QUARRY, LLANDEGLEW

Disused quarry, 1km N of Llandegley, Powys; SO 138 641.

'Striped Flags', C. scanicus Zone; Gorstian Stage, Ludlow Series, Silurian. Mould material.

Apart from the Long Mountain to the north the 'Radnorshire' area (now in Powys) is the only part of the Welsh Basin to have yielded a large number (over 20) of myodocopid ostracod-bearing localities. Most occur in the 'Striped Flags', which consist of finely laminated and banded or 'striped' admixtures of mud and silt, generally with planar lamination or small scale cross-stratification. The characteristic, autochthonous fauna of the Striped Flags consists of a known but little studied and relatively low diversity graptolite-orthocone-bivalve faunal association whose minor associates include supposed pelagic myodocopids, together with rare crinoids, phyllocarids and small brachiopods such as Aegeria and Lingula.

At this locality (Siveter et al. 1987) myodocopids comprise about 10% of a generally sparse, graptolite dominated fauna and occur scattered at very low densities throughout 3-4m of laminated muddy silts. Graptolites include C. scanicus s.l., S. varians, S. chimera semispinosus, P. dubius, P. tumescens and B. bohemicus. Fossils tend to be more abundant in the hemipelagic muds, especially on certain bedding planes. They are also present, but much less common, scattered throughout the muddy

silts, their concentration being diluted by the frequent incursions of sediment. Higher frequencies may again be encountered on the winnowed silt laminae, where they may have been concentrated by the removal of the mud or by current transport.

All the evidence suggests that the relevant depositional area was not within normal epicontinental shelf water zones, but was more likely to have been a shelf margin to shelf slope environment. The 'Striped Flags' lithology represents sedimentation against a background deposition of dark, laminated hemipelagic mud. This 'tranquil' depositional environment was frequently interrupted by incursions of turbid mud silt suspension flows, depositing occasionally graded but otherwise structureless thin muddy silt layers (1-5cm thick). The substrate surface was also worked by low velocity bottom currents, which winnowed out the fines and left thin, clean silt laminae and shell lags, with the elongate fossils becoming parallel orientated. The thinness and high frequency of repetition of these sediment layers is sufficient for them to be compared with present-day marine, 'varve'-like (non-glacial) deposits. The sedimentation model for the latter has hemipelagic muds settling out during the summers, the organic content being heightened by algal blooms. During winters, increased river run off leads to an increased supply of terrigenous material of which the fines (mud and silt) are carried out across the shelf in turbid suspension by storms. The resulting deposits are the thin structureless or graded mud silt layers.

Ostracod fauna: See Siveter 1984, Siveter et al. 1987.

'Bolbozoe' bohémica Barrande, 1872.

STOP 14: CWM AGOL, LLANDEILO DISTRICT

Old quarry 300m S of Cwm Agol Farm, Dryslwyn, 6.5m W of Llandeilo, Dyfed; SN 5655 2070.

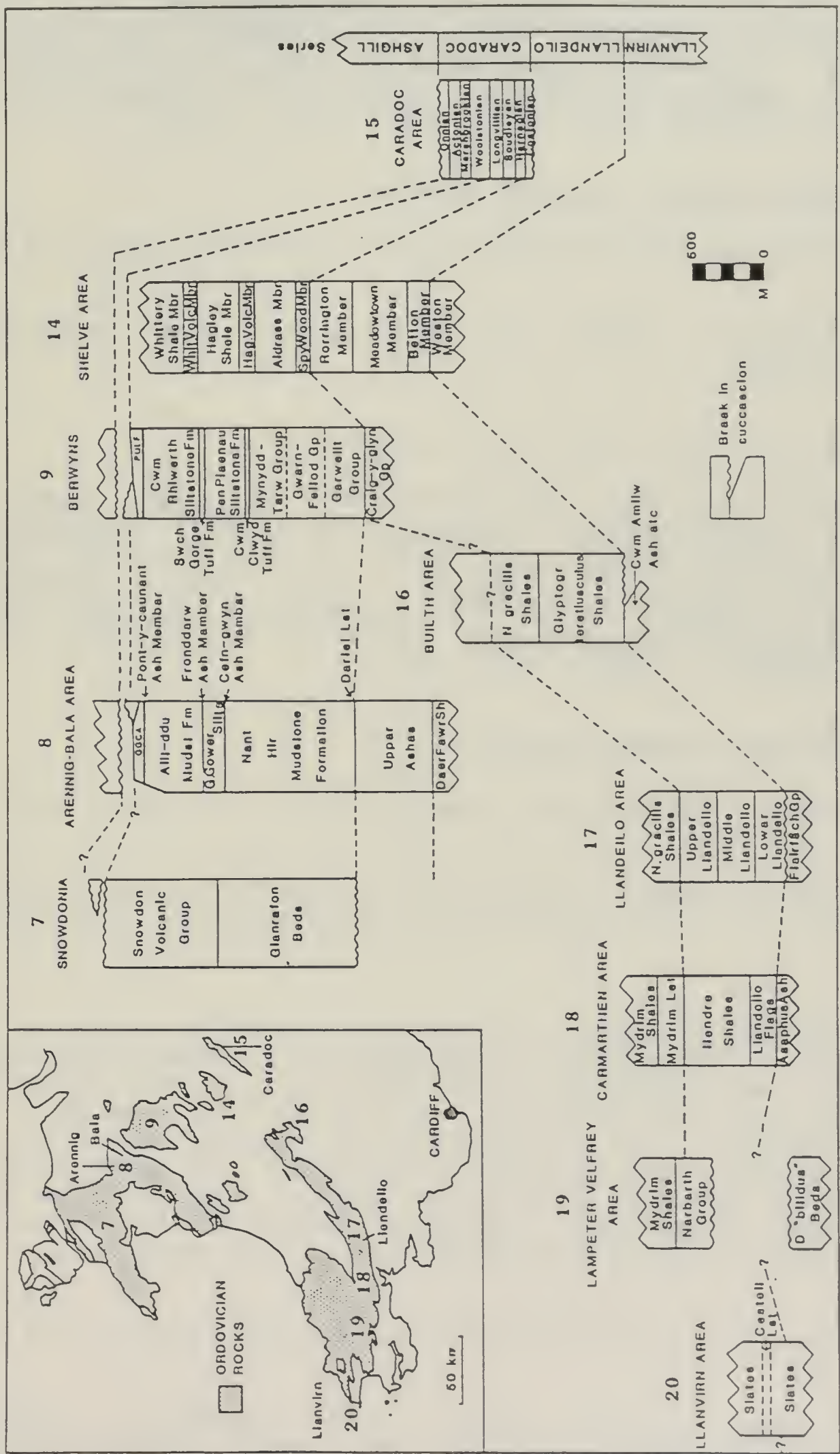
'Llandeilo Flags', middle Ordovician. Silicified material.

This is one of the most important ostracod localities in the Lower Palaeozoic of the British Isles (Siveter 1978a, Jones 1986, 1987). Careful preparation of the limestones using acid techniques can result in yields of thousands of valves per kilo of rock, including for some species reasonably complete ontogenetic sequences. Cwm Agol is the type locality for no fewer than 15 ostracod species.

Addison (1974) recorded a Llandeilo age for this locality based on trilobite evidence. Ostracods indicate an upper Llandeilo age (Jones 1986, 1987).

Ostracod fauna: See Siveter 1978a, 1982b, 1983, 1985b; Schallreuter & Siveter 1983; Jones 1984, 1986 (loc. 17), 1987.

Brephocharieis complicata (Salter, 1848); Ceratopsis britannica Spjeldnaes, 1963; Ceretopsis inflata Jones, 1986*; Cymbolbina susanae Jones, 1986*; Conchoprimitiella dyfedensis Jones, 1987*; Duringia triformosa Jones, 1984*; Easchmidtella elementa Jones, 1987*; Gunnaropsis cristata Spjeldnaes, 1963; Gunnaropsis subvexa Jones, 1986*; hollinacean gen. nov. ? sp. nov. B. of Jones 1987; Homeoceratopsis



Text-fig. 12. Correlation of selected sections in the Ordovician of Wales and the Welsh Borderland (from Jones 1986; modified from Lockley 1983).

jubata Jones, 1986*; Homeoceratopsis ? sp. nov. 1 of Jones 1987; Homeokiesowia epicopa Siveter, 1982*; Latebina pseudantra Jones, 1986*; Leterophores elevatus Jones, 1987; Pariconchoprimitia oscillata Jones, 1987*; Pseudobollia obsoleta Jones, 1987*; Pseudulrichia conispina Jones, 1987*; Severopsis severopsis Jones, 1986; Varilatella (Varilatella) dissita (Schallreuter & Siveter, 1983)*; Vitella fecunda Siveter, 1983*; Vitella vatia Jones, 1986*.

STOP 15: KINCOED QUARRY, CARMARTHEN DISTRICT

Quarry about 500m WSW of Kincoed Farm, 9km E of Carmarthen, Dyfed; SN 5052 2113.

Llandeilo 'Limestone'; middle part of Llandeilo Series, Ordovician. Silicified material.

Ostracod fauna: See Jones 1986 (loc. 12), 1987.

Ceratopsis britannica Spjeldnaes, 1963; Ceratopsis coactilis Jones, 1986; Conchoprimitiella dyfedensis Jones, 1987; Easchmidtella elementa Jones, 1987; Hastatellina ? sp. nov. 1; Histina xanios Jones, 1986*; Pariconchoprimitia improba Jones, 1987; Piretops (Protallinella) ranuncula Jones, 1986; Pseudulrichia conispina Jones, 1987; Schallreuteria (Schallreuteria) cf. S. (S.) superciliata (Reed, 1910); Tallinnella ? tomacina Jones, 1986.

STOP 16: BRYN-BANC, NARBERTH DISTRICT

Large quarry 500m SSE Dyffryn Farm, Llan-Mill, 3km E of Narberth, Dyfed; SN 1415 1450.

Bryn-banc Limestone Member, Llan-Mill Formation, Narberth Group of Addison 1974; probably of Costonian age (basal Caradoc Series). Silicified material.

The argillaceous limestones and flags at this locality contain a rich brachiopod (e.g. Heterorthis, Dalmanella) and trilobite fauna (e.g. Flexicalymene and particularly various trinucleids). Over 25 ostracod species are recorded from Bryn-banc, more than any other locality in the British Ordovician. The ostracods comprise chiefly palaeocopes and binodicopes, together with one eridostracan species. The general area of the quarries, at Llan-Mill, is also the locality from which the first ostracod species ('Beyrichia' complicata Salter, 1848) to be erected from the Ordovician of Wales was collected (see Siveter 1985b).

Ostracod fauna: See Spjeldnaes 1963; Siveter 1978a, 1985b; Jones 1986 (loc. 26), 1987.

Brephochariesis complicata (Salter, 1948); Ceratopsis britannica Jones, 1986; Ceratopsis coactilis Jones, 1986; Conchoprimitiella dyfedensis Jones, 1987; Conchoprimitiella papilalata Jones, 1987; Duringia triformosa Jones, 1984; Easchmidtella elementa Jones, 1987; Eridoconcha plerilamella Jones, 1987; Gunnaropsis narberthensis Jones, 1986*; Gunneropsis subvexa Jones, 1986; Hastatellina ? sp. nov. 1; Histina xanios Jones, 1986; Homeoceratopsis jubata Jones, 1986;

Homeoceretopsis ? sp. nov. 1; Labebina pseudantra Jones, 1986;
Pariconchoprimitia improba Jones, 1987; Pariconchoprimitia oscillata
Jones, 1987; Pedomphalella expraeputia Jones, 1987; Piretopsis
(Protallinnella) ranuncula Jones, 1986; Pseudbollia aff. subaequata
(Ulrich, 1894); Pseudulrichia conispina Jones, 1987; Varilatella
(Redacta) coronata Jones, 1986*; Varilatella (Redacta) sp. nov. 1 of
Jones 1986; Vitella fecunda Siveter, 1983; Vitella vatia Jones, 1986.

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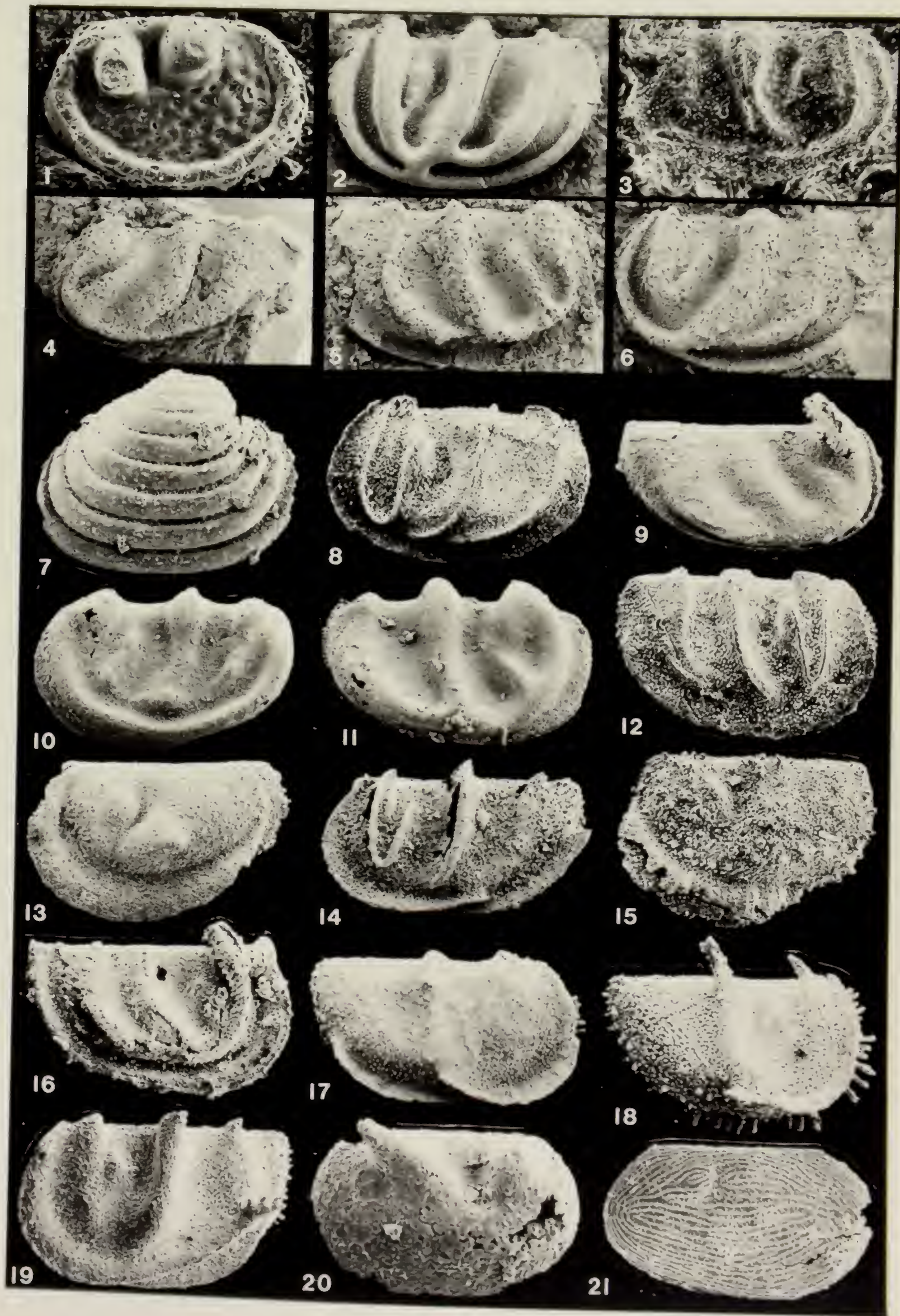
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Explanation of Plate 1

Ordovician ostracods from the Welsh Borderland and South Wales

- Fig. 1 Ulrichia? bicornis (Jones, 1855). BM OS 6673, cast of left valve external mould, x74. Smeathen Wood Formation (= 'Harnage Shales'), Caradoc Series; exposure on south side of B4372 road, 180m WNW of Hope Bowdler Church, Shropshire (SO 4739 9244).
- Fig. 2 Harperopsis scripta (Harper, 1947). GSM 74875A, cast of male left valve external mould, holotype, x18. Harnage Shales, Caradoc Series; 150m E of Cwms Cottage, Caer Caradoc hill track, 2.5km NW of Church Stretton, Shropshire (SO 4816 9493).
- Fig. 3 Varilatella (Varilatella) bulbosa Jones, 1986. BM OS 12609, cast of male right valve external mould, holotype, x25. Horizon and locality as for Fig. 1.
- Fig. 4 Ogmoopsis (Quadridigitalis) siveteri Jones, 1986. On BM slab 3583/A (Whittard coll.), cast of tecnomorphic left valve external mould, x24. Spywood Member, Chirbury Formation, Caradoc Series; Shelve inlier.
- Fig. 5 Piretopsis (Protallinnella) salopiensis (Harper, 1947). GSM 75421C, cast of tecnomorphic right valve external mould, holotype, x25. Spywood Member, Chirbury Formation, Caradoc Series; about 90m S of Rorrington Hall, inside gate on footpath to Kinton, Rorrington, Shropshire (SJ 2984 0062).
- Fig. 6 Harperopsis bicuneiformis (Harper, 1947). GSM 75421A, cast of tecnomorphic left valve external mould, holotype, x26. Horizon and locality as for Fig. 5.
- Fig. 7 Eridoconcha plerilamella Jones, 1987. BM OS 6676, left valve, x65. Bryn-banc Limestone Member, Llan-Mill Formation (Narberth Group of Addison 1974), probable Costonian Stage, Caradoc Series; quarry about 300m N of Bighouse, Lampeter Velfrey, 4.5km E of Narberth, Dyfed (SN 152 147).
- Fig. 8 Varilatella (Redacta) coronata Jones, 1986. BM OS 12615, male left valve, x35. Bryn-banc Limestone Member, Llan-Mill Formation (Narberth Group of Addison 1974), probable Costonian Stage, Caradoc Series; quarry 500m SSE Dyffryn Farm, Llan-Mill, 3km E of Narberth, Dyfed (SN 1415 1450).
- Fig. 9 Ceratopsis brittanica Speldnaes, 1963. BM OS 6663, tecnomorphic right valve, x37. Llandeilo 'Flags', Llandeilo Series; 300m S of Cwm Agol Farm, Dryslwyn, 6.5km W of Llandeilo, Dyfed (SN 5655 2027).
- Fig. 10 Homeokiesowia epicopa Siveter, 1982. BM OS 6670, female left valve, x27. Horizon and locality as for Fig. 9.
- Fig. 11 Brephocharieis complicata (Salter, 1848). BM OS 6666, female right valve, x24. Horizon and locality as for Fig. 9.

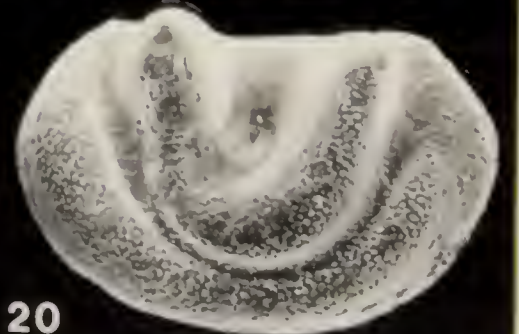
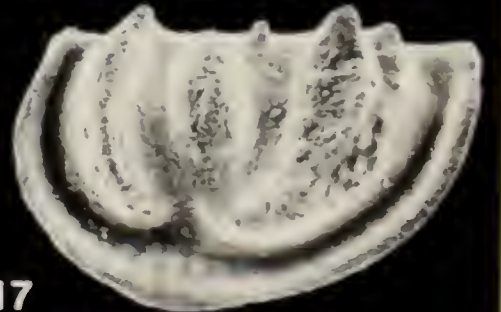
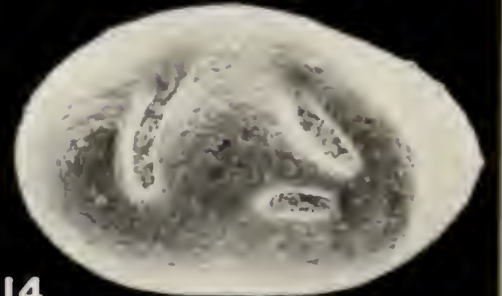
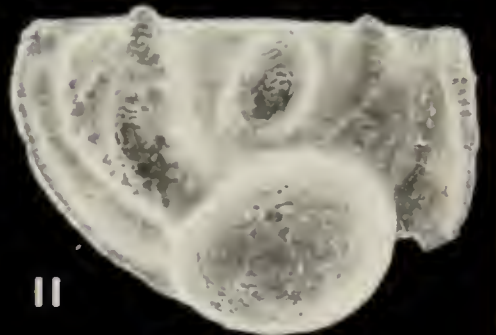
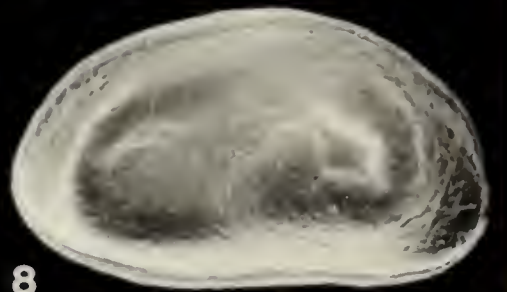
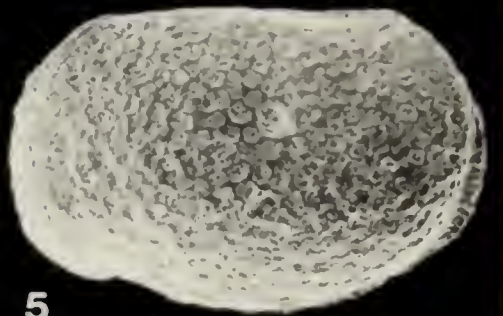
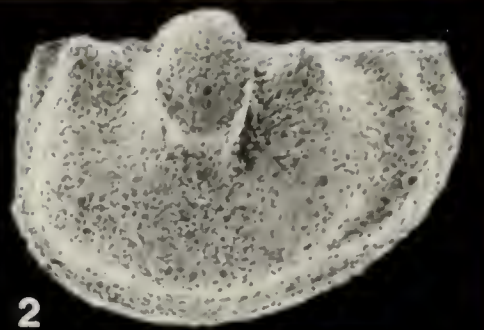
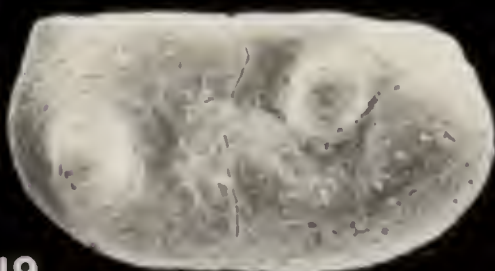
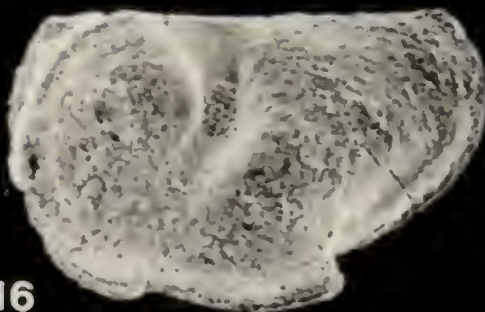
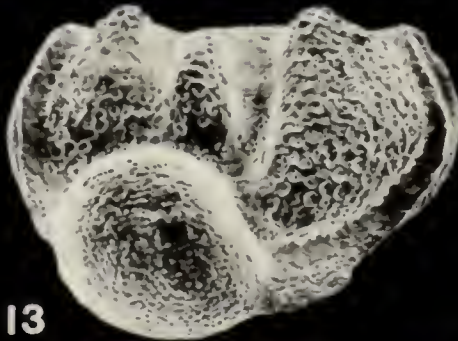
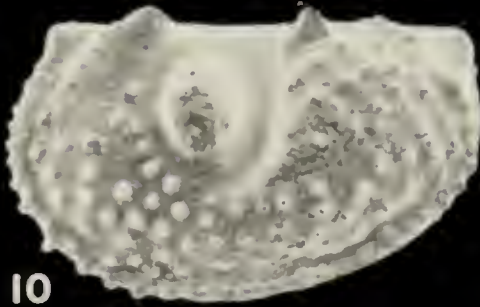
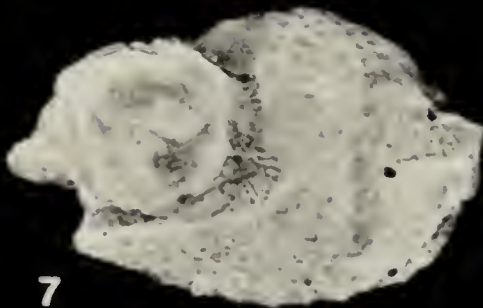
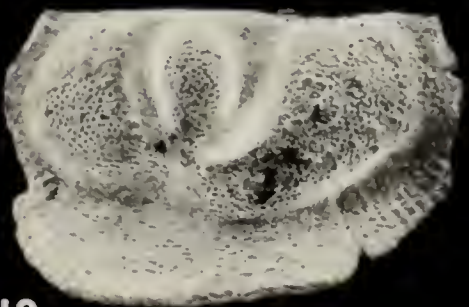
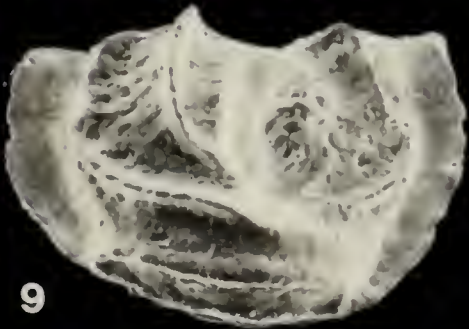
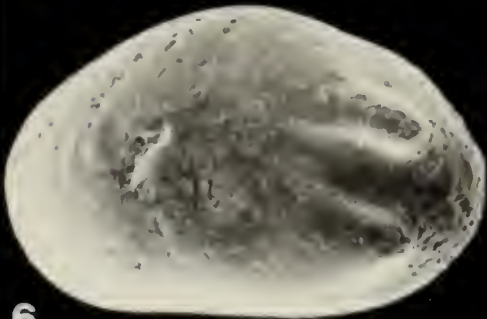
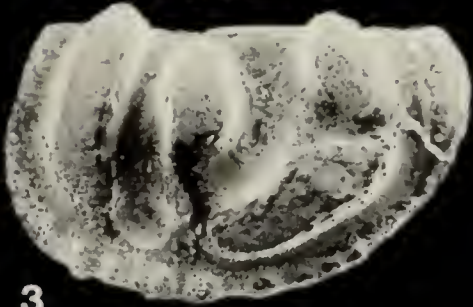
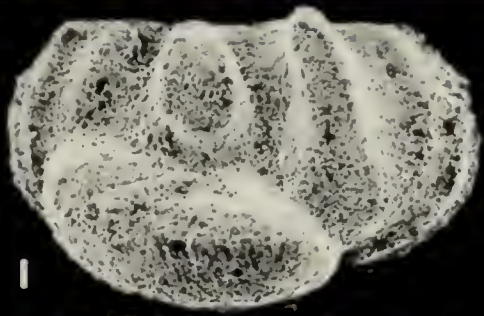


- Fig. 12 Varilatella (Varilatella) dissita (Schallreuter & Siveter, 1983). BM OS 6693, female right valve, x36. Horizon and locality as for Fig. 9.
- Fig. 13 Vitella fecunda Siveter, 1983. BM OS 6672, female left valve, x39. Horizon and locality as for Fig. 9.
- Fig. 14 Gunnaropsis cristata Speldnaes, 1963. BM OS 6667, tecnomorphic left valve, x33. Horizon and locality as for Fig. 7.
- Fig. 15 Duringia triformosa Jones, 1984. BM OS 12261, female left valve, holotype, x40. Horizon and locality as for Fig. 9.
- Fig. 16 Homeoceratopsis jubata Jones, 1986. BM OS 12584, female right valve, holotype, x36. Horizon and locality as for Fig. 9.
- Fig. 17 Cymbolbina susanae Jones, 1986. BM OS 12722, male right valve, x30. Horizon and locality as for Fig. 9.
- Fig. 18 Latebina pseudantra Jones, 1986. BM OS 12731, tecnomorphic right valve, x33. Horizon and locality as for Fig. 9.
- Fig. 19 Histina xanios Jones, 1986. BM OS 12712, female left valve, holotype, x35. Llandeilo 'Limestone', Llandeilo Series; quarry, WSW of Kincoed Farm, 9km E of Carmarthen, Dyfed (SN 5052 2113).
- Fig. 20 Pseudulrichia conispina Jones, 1987. BM OS 6680, right valve, x80. Horizon and locality as for Fig. 9.
- Fig. 21 Conchoprimitiella papilalata Jones, 1987. BM OS 12807, tecnomorphic left valve, holotype, x46. Bryn-banc Limestone Member, Llan-Mill Formation (Narberth Group of Addison 1974), probable Costonian Stage, Caradoc Series; Quarry in Old Garden, 825m SSW of Henllan Lodge, Llandewi-Velfrey, 2.3km NE of Narberth, Dyfed (SN 1313 1600).

Explanation of Plate 2

Silurian ostracods from the Welsh Borderland and mid Wales

- Fig. 1 Londinia arisaigensis Copeland, 1964. BM OS 6612, cast of external mould of female left valve, x20. Platyschisma Shale Member, Downton Castle Sandstone Formation, Pridoli Series; about 1.5m above Ludlow Bone Bed Member, N side of Ludford Lane, about 70m W of junction with A49 road, Ludlow, Shropshire (SO 5119 7413).
- Fig. 2 Frostiella groenvalliana Martinsson, 1963. BM OS 6619, cast of external mould of tecnomorphic left valve, x24. Horizon and locality as for Fig. 1.
- Fig. 3 Neobeyrichia lauensis (Kiesow, 1888). BM OS 6593, cast of external mould of tecnomorphic left valve, x19. Upper Leintwardine Formation, Ludlow Series; track, about 300m W of the Crown Inn at Aymestrey, Hereford & Worcester (SO 4228 6544).
- Fig. 4 Aechmina cuspidata Jones & Holl, 1869. BM OS 6639, left valve, x36. Much Wenlock Limestone Formation, Wenlock Series; old quarries between Cother Wood and Croft Farm, 0.5m W of Malvern, Hereford & Worcester (SO 757 464).
- Fig. 5 Primitiopsis valida (Jones & Holl, 1886). BM OS 6656, female carapace, right lateral view, x45. Lower Elton Formation, Ludlow Series; stream section, about 600m NW of Upper millichope, Shropshire (SO 5785 8987).
- Fig. 6 Thlipsura corpulenta Jones & Holl, 1869. BM OS 6642, carapace, left lateral view, x45. Much Wenlock Limestone Formation, Wenlock Series; Lincoln Hill, about 250m N of River Severn at Ironbridge, Shropshire (SJ 6693 0381).
- Fig. 7 'Bolbozoe' bohémica Barrande, 1872. BM OS 12279, cast of external mould of left valve of open carapace, x9. 'Striped Flags', C. scanicus Zone, Ludlow Series; Friends Meeting House Quarry, near Llandegley, Powys (SO 138 641).
- Fig. 9 Strepula concentrica Jones & Holl, 1886. BM IO 4756, female right valve, x43. Much Wenlock Limestone Formation, Wenlock Series; small quarry, N side of A458 road, crest of Harley Hill, about 1.2km NW of Much Wenlock, Shropshire (SJ 6110 0034).
- Fig. 10 Beyrichia clausa Jones & Holl, 1886. BM OS 6562, male carapace, left lateral view, x22. Horizon and locality as for Fig. 6.
- Fig. 11 Sarmatotoxotis phracata Siveter, 1980. BM OS 6512, female right valve, x34. Horizon and locality as for Fig. 4.
- Fig. 12 Tinotoxotis velivola Siveter, 1980. BM OS 6435, tecnomorphic left valve, x30. Farley Member of Coalbrookdale Formation, Wenlock Series; E side of minor road from Lawley Cross to Wyke, and south of old railway bridge on W side of Tick Wood, about 3km N of Much Wenlock, Shropshire (SJ 6381 0281).



- Fig. 13 Amphitoxotis repanda Siveter, 1980. BM OS 6523, holotype, female left valve, x38. Horizon and locality as for Fig. 6.
- Fig. 14 'Thlipsura' v-scripta Jones & Holl, 1869. BM OS 6645, left valve, x45. Much Wenlock Limestone Formation, Wenlock Series; old quarries N of old road across Hobbs' Ridge, about 0.7km NE of Longhope, May Hill inlier, Gloucestershire (SO 6946 1953).
- Fig. 15 Thlipsura martinssoni Peterson & Lundin, 1974. BM OS 6643, carapace, right lateral view, x31. Buildwas Formation, Wenlock Series; about 130m upstream from river bridge and opposite Buildwas Abbey, Shropshire (SJ 6435 0450).
- Fig. 16 Xysistia auricularis (Jones, 1887). BM OS 12266, male left valve, x42. Coalbrookdale Formation, Wenlock Series; Storridge road cutting, Malverns area, Hereford & Worcester (SO 4758 4853).
- Fig. 17 Sleia pauparata (Jones, 1869). BM OS 6400, male left valve x40. Horizon and locality as for Fig. 6.
- Fig. 18 Craspedobolbina interrupta (Jones, 1887). BM In 27474, lectotype, female carapace, left lateral view, x19. Buildwas Formation, Wenlock Series, Buildwas, Shropshire.
- Fig. 19 Parulrichia diversa (Jones & Holl, 1886). BM OS 6649, right valve, x42. Buildwas Formation, Wenlock Series; bluff on E bank of Harley Brook, about 220m S of junction with Merrishaw Brook, near Domas, Shropshire (approximately SJ 592 003).
- Fig. 20 Bollia bicollina Jones & Holl, 1886. BM OS 6638, x43. Buildwas Formation, Wenlock Series; bluff on E bank of Harley Brook, near Domas, Shropshire (SJ 5922 0030).

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